

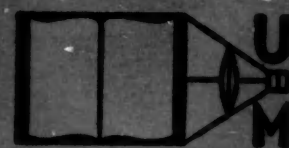
Vol. XXII

No. 3

DISSERTATION ABSTRACTS

*ABSTRACTS OF DISSERTATIONS AND
MONOGRAPHS IN MICROFORM*

UNIVERSITY MICROFILMS, INC.
ANN ARBOR, MICHIGAN: 1961



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AGRICULTURE

AGRICULTURE, GENERAL

EXPERIENCES OF BEGINNING COOPERATIVE EXTENSION AGENTS AND THEIR IMPLICATIONS FOR AN INDUCTION TRAINING PROGRAM

(Order No. 61-3091)

Billy Lee Coffindaffer, Ph.D.
The University of Wisconsin, 1961

Supervisor: Assistant Professor Glenn V. Fuguitt

Purpose

This study was designed to analyze work experiences and training experiences of Cooperative Extension Agents during their first year of extension employment. Work experiences were analyzed in terms of tasks in eight selected competency areas: program planning, leadership development, extension teaching methods, organization of group, responsibilities and function of agent, office management, communication, and public relations. Training experiences in school, during the first year of extension employment and in previous employment were distinguished.

Specific objectives of the study are:

1. To set forth the experiences of extension workers during their first year of extension employment relative to their performance and difficulty experienced in specific work areas.
2. To set forth training experiences provided for extension workers prior to and during the first year of extension employment relative to specific tasks within selected areas of extension work.
3. To relate agent's performance of specific work tasks and difficulty experienced in performing these tasks to previous training, specifically to training received on the job and in school.
4. To ascertain when, during the first year of extension employment, agents feel that beginning extension workers should receive training relative to the tasks in this study.

Results of this study should have direct application for the development of an in-service training program for beginning extension agents.

Procedures

A mailed questionnaire was used to gather information from 134 county extension workers who had been employed in the Cooperative Extension Service for at least one year but less than two years. These respondents represent ten

states in the Northeast Extension Region of the United States.

Through a content analysis of monthly reports of county extension workers in Wisconsin, specific work tasks were selected to assess the experiences of beginning extension workers in the eight competency areas included in this study.

The data were analyzed by position within the extension service. In this way differences in results for county agents, 4-H Club agents and home demonstration agents were ascertained.

Analysis was carried out by means of contingency tables.

Summary

1. The tasks in this study were performed by most of the respondents and a rather large proportion had experienced difficulty in performing the tasks.
2. There were wide variations between tasks and areas with respect to difficulty in performing the tasks.
3. A very small proportion of those agents performing the tasks indicated having performed the tasks poorly.
4. The agent's perception of performance was associated with difficulty experienced in performing the tasks.
5. Approximately one-half of the respondents performing the tasks indicated having received training in the tasks.
6. The proportion of agents receiving training in tasks in school was considerably smaller than the proportion receiving training during the first year of extension employment, while the proportion of agents receiving training from previous jobs and other sources was quite small.
7. There is an association between training and difficulty, with a lower proportion of those trained in a task perceiving it as difficult, as compared with those not trained. Similarly there is an association between training and the agent's perception of how well they performed a given task.
8. A large proportion of the respondents indicated that they felt training during the first month would be desirable for beginning extension workers in the areas Responsibilities and Function of Agent and Office Management. A large proportion also indicated training desirable between the second and sixth month in the areas Communications and Public Relations and training desirable between the second and twelfth month in the areas Program Planning, Leadership Development, Extension Teaching Methods, and Organization of Group with primary emphasis in these areas during the first six months.

Microfilm \$2.75; Xerox \$6.80. 142 pages.

AN ANALYSIS OF THE ORGANIZATIONAL
GROWTH OF THE ARKANSAS
COOPERATIVE EXTENSION SERVICE

(Order No. 61-3115)

Andrew Leon Holley, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor George B. Strother

Purpose and Objectives

Two general guides for staffing were given in the laws that established the Arkansas Cooperative Extension Service. The literature provides little empirical information concerning determinants of the number and distribution of Extension personnel. Therefore, specific guides for effectively utilizing Extension staff would be useful to administrators. Before such guides can be stated, growth of the organization and changes in the distribution of its personnel must be studied in relation to relevant variables.

This was a quantitative case study of the growth of the Arkansas Cooperative Extension Service. Emphasis was placed on the questions of staff growth, and the relationship between factors within and external to the organization.

The objectives were: (1) to study the characteristics of the growth of the Arkansas Cooperative Extension Service and identify some of the variables related to increase in staff size; (2) to study changes in the distribution of personnel within the organization as its staff size increased; and (3) to consider the analyses relative to findings and theoretical predictions of Mason Haire for industrial organizations.

Methodology and Procedures

Patterns of change during the period 1915 to 1960 were studied for the following five variables: (1) number of farms, (2) total population, (3) average sales per farm, (4) assessed valuation, and (5) rural population. Each of these variables was correlated with the number of Extension personnel on a county basis for the years 1940, 1950, and 1960 and multiple correlation was used to determine how much of the variance in number of personnel could be accounted for by combining the foregoing factors.

Changes in distribution of personnel within the organization were considered from two points of view; (1) changes in terms of Extension classifications of personnel, and (2) changes in terms of classifications of personnel used in theoretical formulations of organizational growth. Using this second type of classification, data were compared with similar data obtained for industrial organizations and with predictions of the theory of organizational growth proposed by Mason Haire.

Summary of Findings

The five variables studied relative to number of personnel showed dissimilar patterns of change for the period 1920 to 1960; none of the five patterns was similar to that for total number of personnel.

Each of the five variables correlated at the .0005 level of confidence with total number of personnel on a county basis for the years 1940, 1950, and 1960. The highest correlation was between rural population and total personnel.

Multiple correlation accounted for little variance other than that attributable to individual variables.

Increase in total number of Extension personnel between 1915 and 1960 was almost entirely an increase in county personnel. There was only a moderate increase in number of specialist and state office clerical employees.

In agreement with the findings and theoretical predictions of Mason Haire for industrial organizations, the following changes in the distribution of the staff of the Arkansas Cooperative Extension Service occurred as the organization increased in size: (1) "inside" employees increased by a cube function as "outside" employees increased by a square; (2) growth patterns for line and staff personnel were very nearly parallel; (3) the ratio of supervisors to supervised decreased steadily; (4) the number of management personnel increased, but more slowly than total personnel. Thus, this group accounted for an increasingly smaller part of the total; and (5) the number and proportion of clerical personnel increased.

In general, growth of the Arkansas Cooperative Extension Service was very similar to that of the industrial organizations studied by Haire and was as predicted by his theory of the growth of organizations.

The future size and composition of the Arkansas Cooperative Extension Service may be in part predicted by the growth patterns described. The ultimate form and size, however, depend on the objectives which Extension personnel may formulate and the public support. Extrapolation of historical trends may aid but cannot take the place of rational self-determination by Extension personnel.

Microfilm \$2.75; Xerox \$8.60. 190 pages.

THE PHYSICAL AND CHEMICAL
PROPERTIES OF SOILS AND GROWTH
OF PLANTS AS AFFECTED BY
IRRIGATION WITH SEWAGE EFFLUENT

(Order No. 61-3164)

John Roy Sessing, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor L. E. Engelbert

Modern industrial growth and population expansion have high-lighted the pressing need for adequate and economical purification and disposal of mounting industrial and domestic wastes. In many instances, waste disposal has been combined satisfactorily with crop irrigation; but dependent on the nature of the applied waste, this practice may result either in improvement or deterioration of soil physical and chemical properties.

Lysimeter irrigation studies involving the use of a high sodium effluent as an irrigant were undertaken in order to evaluate the effect of treatment on soil physical and chemical properties and on plant growth. These investigations were conducted on cropped Miami silt loam, Muck, and Plainfield sand. A 10-year study initiated on six small lysimeters, 1/10,000 acre in size, was later extended to larger units, 1/24 acre in size.

Large quantities of nitrogen, phosphorus and potassium were added to the small lysimeters by effluent application. The resultant improved fertility status effected an increase

in hay yields of high quality. While approximately 60% of the effluent-added phosphorus and potassium was retained by the soil in fixed forms, an unaccountable loss of nitrogen occurred. This loss of nitrogen was presumably the result of volatilization through denitrification during periods of anaerobiosis. It was observed that soil "filtration" and retention of nitrogen, phosphorus and potassium carried in the effluent was confined almost wholly to the surface 12 inches of the lysimeter profiles.

Addition of calcium, magnesium and sodium by the effluent were also extensive; however, the predominance of sodium (chiefly as NaCl) resulted in wholesale displacement of exchangeable calcium and magnesium with concomitant sodium saturation of the soil. Sodium saturation of the small lysimeters over the 10-year period increased from 8 to 20 times that of a similar soil receiving water as the irrigant, and in the case of the silt loam soil, resulted in a sodium saturation in excess of the critical 15% level.

Severe soil physical impairment associated with the high percentage sodium saturation especially of the effluent irrigated Miami silt loam was evidenced by decreased non-capillary and increased capillary pore voids, increased moisture holding capacity, decreased total porosity, and marked deterioration in aggregation and water stability of aggregates. The observed and measured soil physical breakdown was associated chiefly with the 12 to 42-inch depth of the profiles.

Studies on large lysimeters indicated that a high volume effluent application to a fine-textured soil caused no severe injury to a crop such as brome grass; the resultant slight yield increase would not justify application above an optimum rate unless disposal was the major goal. The linearity of yields of alfalfa with rates of waste application to a sandy soil suggests that sands are well suited to high volume disposal of waste waters.

Yields of hay and corn were substantially greater on effluent than on water and non-irrigated lysimeters; however, it was evident that the nutrient supplied by effluent alone could not maintain a crop indefinitely without supplemental fertilizers, since crop uptake in some cases was in excess of the nutrients added at the optimum level of effluent application.

Soil "filtration" of pathogenic and enteric organisms was almost complete when judged from the standpoint of the coliform index. Reductions in *E. coli* from 10 million in the effluent to 40 to 70 per 100 ml. were observed. In this respect, a sand proved to be the most effective "filter." However, chemical analyses pointed to the fact that ground water derived from the effluent was of very poor quality.

Microfilm \$2.75; Xerox \$6.60. 136 pages.

WHEY, ITS EFFECT ON SOIL AND PLANT GROWTH.

(Order No. 61-3161)

Warren James Sharratt, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor A. E. Peterson

Whey is the by-product produced when milk is made into cheese. Whey contains approximately 93 per cent water, 5 per cent lactose and small quantities of fat, protein, and minerals.

About one-third of the total quantity produced is wasted by dumping in rivers, sewers, and ditches constituting the waste of a valuable by-product and often creating a serious hazard through stream pollution and overloading of municipal sewer systems. Recent regulations governing the disposal of whey have caused the dairy industry to seek new means of using this by-product. However this is complicated by the seasonal nature of the whey supply since more than 65 per cent of the whey is produced in March, April, May, and June. Whey contains nutrients essential for plant growth and its use as a soil amendment may be possible. This study involved adding quantities of whey to the soil in early spring prior to corn planting. Its effects on soil were studied over the following two growing seasons.

Whey was applied to field plots at rates of 2, 4, 8, and 12 acre inches in the spring of 1959. These applications were made over a three week period. Regardless of the rate of application the total applied was evenly distributed over this period. Analyses of the applied whey shows that one acre inch contains 340 lbs. of nitrogen, 260 lbs. of phosphate, and 540 lbs. of potash. It would cost about \$100.00 to purchase these nutrients as commercial fertilizers.

Analyses of the soil at the end of the second growing season indicated that the fertility level was still adequate to successfully grow corn in succeeding years without additional fertilizer.

Conductometric determinations on the soil that received 8 and 12 acre inches of whey indicate that salts sufficient to restrict plant growth may accumulate in the plow layer the first season after application, but with normal precipitation this is no problem the second year. Whey applications gave no change in soil pH.

Corn was planted on all plots in 1959 two weeks after the last whey application. No further whey applications were made for the remainder of the experiment. The addition of 2 acre inches of whey gave yields of 120 and 95 bushels per acre while the control yielded 85 and 65 bushels per acre in 1959 and 1960 respectively. Twelve acre inches gave yields of 106 bushels per acre in 1959 and 117 bushels per acre in 1960 respectively. This indicates that 2 and 4 acre inches are more desirable for corn production the first year after application, while 8 and 12 acre inches are better for the second year of corn. This is believed to be due to the biological environment existing in the soil receiving heavy whey applications.

Adding whey increased the content of potassium, manganese, nitrate nitrogen, and phosphorus in the plant tissue and reduced the content of calcium and magnesium. No sodium was taken up by the plants.

From an aggregation analysis of soils at the end of the

first and second growing season it was generally concluded that whey improves soil aggregation.

A study of root development on 20-day old corn plants indicated that all rates of whey stimulated root growth.

A laboratory and field experiment on the production of nitrates in soils receiving whey indicated that the organic nitrogen in whey is readily converted to nitrate nitrogen. There was a direct, but nonlinear relationship between the amount of nitrates formed and the quantity of whey added. This conversion began about two weeks after corn planting and continued throughout the first growing season. During the second and third growing seasons nitrates continued to be produced at reduced rates, but still in amounts which could help supply a plant with its vital nitrogen needs.

Microfilm \$2.75; Xerox \$5.20. 101 pages.

AGRICULTURE, ANIMAL CULTURE

MINERAL AND FAT INTERRELATIONSHIPS AS INFLUENCING RATION UTILIZATION BY LAMBS

(Order No. 61-3032)

Kenneth Lewis Davison, Ph.D.
Iowa State University of Science and Technology, 1961

Supervisor: Wise Burroughs

The objectives of this work were to study calcium-fat interrelationships as influencing digestibility of rations containing alfalfa hay or corncobs by lambs and to verify these results with growing-fattening experiments. Mixtures of trace minerals were added to rations containing fat in an attempt to improve performance of fattening lambs. Circulating total blood lipids were measured as an indication of fat absorption.

The addition of 5 per cent corn oil to rations containing 46 per cent corncobs decreased digestibility of organic matter, protein and cellulose. Total Calories digested were not increased by the addition of corn oil. Calcium, as the carbonate or the chloride, increased digestibility of all components measured when added to the basal ration but greatly increased digestibility of rations containing corn oil. Total Calories digested were greatly increased when calcium was added to rations containing corn oil which was interpreted as an increased utilization of the corn oil. Magnesium did not increase digestibility of a ration containing corn oil.

The addition of 5 per cent corn oil and/or 1 per cent calcium carbonate did not alter percentage digestibility of a ration containing 40 per cent alfalfa hay which resulted in a digestion of approximately 500 more Calories daily by the lambs fed corn oil than the controls. The addition of corn oil saved about 1 pound of feed per pound of gain and tended to improve rate of gain, carcass grade and dressing per cent of lambs fed the 40 per cent alfalfa hay ration in a growing-fattening study. The addition of 5 per cent corn oil to a ration containing 40 per cent corncobs did not improve rate of gain, feed efficiency, carcass grade or dressing per cent. Rate of gain, feed efficiency, carcass grade

and dressing per cent of lambs were not improved when 5 per cent stabilized white grease was fed in combination with various calcium and trace mineral levels in corncob rations.

Calcium additions tended to increase rate of gain of lambs fed a 40 per cent corncob ration containing 0.24 per cent calcium. Calcium, or trace mineral, additions did not improve performance of fattening lambs fed rations containing 0.3 per cent or more calcium.

Within the limits of this study, the feeding of 5 per cent stabilized white grease or of large intraruminal doses of corn oil did not appreciably alter total systemic blood lipids of lambs.

Microfilm \$2.75; Xerox \$4.80. 92 pages.

FACTORS CONCERNED WITH FERTILIZATION FAILURE AND EMBRYONIC DEATH

(Order No. 61-3139)

Alan Carl Menge, Ph.D.
The University of Wisconsin, 1961

Supervisors: Professor L. E. Casida and
Professor W. J. Tyler

A study was made of the differences between families of Holstein cows under the conditions of outbreeding and inbreeding in the lengths of the postpartum intervals until formation of the first corpus luteum, the occurrence of first estrus and the occurrence of uterine involution. The mean lengths of the three intervals were 18.9, 32.4 and 42.3 days, respectively. Family and system of mating had a significant interaction ($P < 0.05$) on the interval to first estrus. The uteri of the inbred cows involuted significantly earlier ($P < 0.01$) than those of the outbreds (39.6 vs. 45.0 days). The incidence of cystic ovaries differed significantly ($P < 0.05$) between families. Certain of the reproduction traits were found to be associated with milk production.

Immune sera produced against rabbit sperm and bull sperm prevented fertilization of ova when the sperm used to inseminate females were treated with the sera. Fertilization was prevented in rabbits bred with semen treated with the gamma globulin fraction of the immune sera but not with that of normal sera.

Absorption of the specific antisera against sperm with erythrocytes of the respective bulls and male rabbits did not remove either the sperm agglutinins or the antifertility effect of the sera. Absorption of these sera with the appropriate sperm removed the agglutinins and the antifertility effect. Antisera to erythrocytes did not possess either specific sperm agglutinins or the antifertility effect when used to treat semen. Similarly, antisera against sperm did not contain specific erythrocyte antibodies. *In vitro* tests revealed the sperm antigens of bulls and rabbits are not cross-reactive.

Immune sera against rabbit sperm when used in transplanting one-day old rabbit embryos to foster mothers did not show a consistent effect on the survival rates of these embryos at 28 days. A significant increase ($P < 0.01$) in embryonic death occurred among nine-day old embryos that were treated *in utero* with immune sera as compared to those treated with normal sera. Immune sera against

rabbit erythrocytes had no effect on the survival rates of embryos treated at either stage of development.

Rabbit and bull sperm were injected into the ligated uteri of estrual and luteal phase rabbits to study factors affecting the biological disposal of sperm from the uterus. The number of sperm recoverable at 38 hours was significantly less ($P < 0.05$) than at 20 hours after injection. Fewer bull sperm were recovered from the uteri of estrual rabbits than from luteal rabbits, and also fewer than rabbit sperm from either type of rabbit. However, fewer rabbit sperm were recovered from the luteal phase uteri than from the estrual phase.

Killing the sperm prior to injection decreased significantly ($P < 0.05$) the recovery rate of bull sperm while no difference was observed with rabbit sperm.

Recovery rates of bull and rabbit sperm from estrual rabbits were increased significantly ($P < 0.05$) by diluting the sperm prior to injection with uterine exudates induced by bull sperm as compared to diluting with saline or uterine exudates induced by rabbit sperm.

The recovery rates of sperm did not vary with species of sperm injected or reproductive phase when studied in leukopenic rabbits.

Differences, except those observed between normal and leukopenic rabbits, in the recovery rate of sperm could not be explained on the basis of leukocyte numbers only.

Microfilm \$2.75; Xerox \$6.60. 139 pages.

RESULTS OF SELECTION FOR PRODUCTION IN A HOLSTEIN HERD

(Order No. 61-3052)

Robert Eugene Walton, Ph.D.

Iowa State University of Science and Technology, 1961

Supervisor: Jay L. Lush

This study was concerned with determining genetic gain through selection for milk production in the Iowa State University Holstein herd. The data included 685 cows with 1,747 lactations made during the period 1930 through 1958. All lactations were adjusted to a 243-day, two-time milking, mature equivalent and non-inbred basis. Additional age factors were computed to correct for a bias which seemed to exist in the standard age factors as applied to 243-day records in this herd.

Repeatability values were computed both by intraclass correlation and by regression. Intraclass correlation estimates ranged from 0.40 to 0.44 for milk and from 0.28 to 0.35 for fat. Weighted regression estimates were 0.514 and 0.513 for milk and fat, respectively.

Intensity of selection was evaluated for dams of sires, dams of cows and sires of sires. Their genetic superiority as a percent of the mean was found to be 7.07, 1.24 and 1.37 percent, respectively. The breeding system followed in this herd precluded selection of sires of cows and also limited the intensity of selection for sires of sires. An average genetic gain for the 29-year period of 0.60 percent of the mean per year was expected from the selection practiced. The selection intensity was roughly two and one-half times as strong in the latter half of the period studied as in the first half. The increased intensity was

attributed to having attained a more or less constant herd size, the formal use of a selection index after 1941, and fewer deaths and fewer discards for purposes of disease control.

Estimates of genetic and environmental trends were computed from a maximum likelihood model. Data corrected by the standard age factors gave decreases in environmental trends and increases in genetic trends that seemed unreasonably large when compared with the expected changes. Data corrected by age factors derived from these same data showed moderate increases in both genetic and environmental trends that agreed reasonably well with the genetic gain expected from the selection practiced.

Overcorrection of first lactations and inclusion of low terminal lactations were shown to introduce strong negative biases in computed environmental trends. The use of inflated repeatability values had a similar, though much less extreme, effect on computed trends.

The small biases introduced through incorrect age factors tended to cancel when computing selection intensities but accumulated and caused large errors in the trends estimated by the maximum likelihood method.

Microfilm \$2.75; Xerox \$7.00. 149 pages.

AGRICULTURE, FORESTRY AND WILDLIFE

A MICRO-CLIMATIC STUDY OF AIR DRYING UNIT-PACKAGED LUMBER IN FORT COLLINS, COLORADO.

(Order No. 61-2931)

Harry Emerson Troxell, D.F.
Duke University, 1961

Co-chairmen: A. E. Wackerman and E. S. Harrar

This study was designed to examine the restricted climatic conditions in and around unit packages of lumber. The physical factors of air temperature, relative humidity, and air velocity were measured systematically for unit-packaged lumber during two summer seasons. These factors were correlated with the drying rate of the one-inch lumber by multiple regressions. Measurements were taken at noon in two pre-selected locations associated with each package once every 48 hours during six two-week drying periods. One location was on the interior of the package near the bottom; the other location was at an external location along the side. Two methods of stacking lumber were compared, each being replicated five times. In one method, boards were placed edge-to-edge on the courses; in the other, there was a two-inch space between boards. A total of 30 unit packages of lumber were observed for each of the two treatment methods.

Thermoelectric thermometry was adapted to field conditions for making micro-climatic measurements. This consisted of three separate copper-constantin thermocouple circuits connected to a potentiometer through a selector switch. The three sensitizing elements were mounted on a probe to facilitate placing them inside the

lumber packages. One element indicated "dry-bulb" temperature; the second was a thermocouple wrapped with a fine cotton filament to determine "wet-bulb" depression, and the third element was a thermocouple anemometer. The drying rate of the lumber was based upon two whole-board samples in each study package.

The air drying conditions experienced in this study reduced the moisture content of the one-inch lodgepole pine lumber to an average of 12 percent. Differences were observed between the two-treatment methods. In the loosely constructed packages, a turbulent air-flow pattern was observed inside the unit-packages; whereas, the more compact packages had a stratified air flow pattern. The greater air turbulence reflected a slightly faster drying rate for the loosely constructed packages.

In the analyses where multiple regressions were used, the average lumber moisture content in percent was expressed as a second degree function of time and the micro-climatic factors for the two stacking methods. The micro-climatic factors correlated were expressions of the differences between and the sums of the factors observed at the external and internal positions for each unit package. In both methods of stacking, time was highly significant; however, the micro-climatic factors in the tightly constructed lumber packages indicated no additional effect to the regression. The loosely constructed packages revealed that the temperature coefficients were highly significant, and that the drying rate was slightly faster than in the tightly controlled packages. Before the method can be translated into air drying practices, other variables remain to be evaluated. Microfilm \$2.75; Xerox \$4.20. 77 pages.

AGRICULTURE, PLANT CULTURE

BREEDING BEHAVIOR OF *AVENA* *ABYSSINICA* X *AVENA* *STRIGOSA* AMPHIPLOIDS AND OF PROGENIES FROM CERTAIN INTERSPECIFIC *AVENA* HYBRIDS

(Order No. 61-3103)

Robert Arnold Forsberg, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Hazel L. Shands

The breeding behaviors of (a) two *Avena abyssinica* x *A. strigosa* amphiploids, two derived tetraploids, and a natural tetraploid, and of (b) derivatives from crosses between these oat types and *A. sativa*, were studied. Plants in *A*₄ through *A*₈ amphiploid lines varied in heading date from earlier than their tetraploid parent to later than their diploid parent. Nine related *A*₆ lines varied significantly in height from 38 to 45 inches. Plants with light colored kernels were found in three *A*₅ or *A*₆ lines from dark-kerneled parent plants. Plants in most *A*₄ through *A*₈ progeny lines were not uniform in their crown rust reaction. Amphiploid seedling root tip cells showed intra- and inter-plant chromosome number variations, usually in the vicinity of 42 chromosomes. Over one-half of the 1957 *A*₅ and *A*₆ progenies were more than 10% lower in percentage

self fertility than that of their parent plant, an indication of the unpredictable performance of the amphiploid plants regarding this characteristic. Nevertheless, in 1958, 23 of 25 selected *A*₇ progenies from 2 *A*₆ plants with high self fertility (82%) were similar in fertility ($\pm 10\%$) to that of their parent plant. This suggests that with continued selection, amphiploid lines stabilized at higher fertility levels might be obtained. No gross variation in progeny chromosome-number mode occurred (a) as the level of parent-plant fertility increased or decreased or (b) in crown rust resistant versus susceptible sister plants. There was a considerable range in self fertility among crown rust resistant and susceptible *A*₄ through *A*₇ amphiploid plants. Amphiploid[♀] x *A. sativa*[♂] pollinations in greenhouse series gave 17.3% seed set (212 of 1225). A highly significant correlation coefficient ($r = .377^{**}$) was obtained between percentage crossed seed set on greenhouse amphiploid plants and their self fertility. Amphiploid[♀] x *A. sativa*[♂] *F*₁ and *F*₂ plants were highly cross and self sterile, but *F*₃ plants were vastly improved in self and cross fertility. Twenty-two *F*₂ plants with amphiploid-type crown rust resistance had 37 resistant and 28 susceptible *F*₃ progenies. Nearly half of the *F*₄ and *F*₅ progenies, from the few crown rust resistant *F*₃ and *F*₄ plants initially obtained, were crown rust resistant. Crown rust resistant, amphiploid x *A. sativa*² (first-backcross) *F*₂ and *F*₃ plants had a low proportion (10-35%) of crown rust resistant *F*₃ and *F*₄ progenies; segregation continued in *F*₅ lines. Second- and third-backcross derivatives from crosses in which the *A. sativa* parent was used as the recurrent male varied considerably in self fertility. In 1960, for the first time, seeds were obtained when *A. sativa* was pollinated with amphiploid x *A. sativa*, crown rust resistant derivatives. Early generation derivatives from crosses between three tetraploid selections and *A. sativa* varied considerably in crown rust reaction and in self fertility.

Microfilm \$2.75; Xerox \$8.00. 174 pages.

A STUDY OF PROGENIES OF A COLCHICINE TREATED *F*₁ HYBRID OF *ZEA* MAYS L.

(Order No. 61-3059)

Donald Elmer Kratochvil, Ph.D.
South Dakota State College, 1961

Supervisor: Professor D. Boyd Shank

Field studies of 140 *F*₂ lines derived from colchicine treated plants of the maize single cross SD5 x SD7 were made to establish the possibility of duplicating the production of true-breeding homozygous variants as reported for sorghum. These 140 lines were compared with 60 non-treated *F*₂ lines out of the same cross. The results obtained did not indicate differences between the treated and untreated material, either as entire classes or as individual lines, for these six phenotypic measurements: plant height, ear height, stalk diameter, ear length, ear diameter and ear weight. Nor were differences in variability within individual treated progenies, or treated progenies as a class, established in comparison to the controls. No clear-cut evidence for the recovery of homozygous variants or inbred lines in one generation as a result of colchicine

treatment of the single cross could be demonstrated. Some reasons for the differential performance of this single cross as compared to the sorghum variety Experimental 3 are given, and some suggestions are made with regard to the direction of further work.

Microfilm \$2.75; Xerox \$4.20. 76 pages.

EFFECT OF WEED CONTROL
PRACTICES ON THE VARIATION
IN CARBOHYDRATE CONTENT AND
WEIGHT OF VERNONIA BALDWINI ROOTS

(Order No. Mic 61-1970)

Dean Leroy Linscott, Ph.D.
The University of Nebraska, 1961

Adviser: M. K. McCarty

In spite of numerous investigations that had been conducted in the field of weed control, further research was needed regarding the physiological responses of perennial plants to weed control practices. Ironweed (Vernonia baldwini Torr.) was chosen as the plant to be studied. Principles established in the study of ironweed would probably be applicable to pasture species of similar growth habit.

The objectives of the experiment were to determine: (1) why repeated herbicidal treatments were required to kill some perennial broad-leaved species when single applications often sufficed to kill other species, (2) why annual mowing treatments did not reduce the population of pasture weed species at Lincoln, Nebraska to the extent reported at other locations. Further understanding of the variation in carbohydrate content of ironweed roots as affected by weed control treatments, stage of growth, and climatic conditions would give insight into the problems.

A study was made of the variation in ironweed root carbohydrate contents as affected by long and short term weed control practices. The investigation was conducted in an experimental pasture near Lincoln, Nebraska. Ironweed root samples were taken at weekly intervals during May, June, and July; twice monthly during April, August, and September; and monthly during October and November in 1958 and 1959. Samples were collected from a specific volume of soil. Roots were analyzed quantitatively for reducing sugars, sucrose, fructosans, total carbohydrates, water content, and dry weight. Paper chromatographic, enzymatic, and chemical techniques were used to identify the carbohydrate components.

A fructosan, rather than starch, was found to be the main carbohydrate constituent of ironweed roots. The fructosan was tentatively identified as inulin. Fructose composed the greater part of the reducing sugar fraction and lesser quantities of glucose and other non-identified gluco-fructosans made up the remainder. Sucrose was the only disaccharide identified.

Considerable variation in ironweed root carbohydrate content of non-treated plants occurred throughout the season. The changes in carbohydrate were inter-related to season, treatment, and stage of growth.

Ironweed plants that had been subjected to nine annual mowing treatments contained the same root carbohydrate

percentages as did the control plants even though the plants that had been mowed were 3 to 5 weeks behind the controls in stage of growth. Control plants produced approximately $2\frac{1}{2}$ times more roots by weight than mowed plants.

Plants subjected to initial 2,4-D (2,4-dichlorophenoxyacetic acid) spray applications were found to increase in sucrose concentration immediately after treatment. There were no differences in sucrose concentration between control and sprayed plants at the end of the season. Sucrose concentrations were not affected by a second year of 2,4-D spray application.

Ironweed plants subjected to an initial mowing treatment decreased immediately in fructosan content. However, fructosan concentrations approached the control levels by the end of the season. No differences in carbohydrate levels were found between mowed and control plants the second year of treatment. Plant root weights in mowed plots were decreased significantly after the second year of treatment.

It was concluded that reduction in ironweed vigor as a result of annual mowing treatments was caused by the reduction in available energy material. This reduction was indicated by a decrease in the root system rather than a permanent decrease in carbohydrate percentage. Annual mowing treatment effects were considered to be within the range of tolerance of ironweed in Nebraska. It was concluded that the effect of 2,4-D on carbohydrate levels was temporary and not contributing to killing ironweed. Use of root carbohydrate percentage alone in defining a physiological condition of ironweed was considered to be a questionable procedure.

Microfilm \$2.75; Xerox \$4.20. 77 pages.

CHEMICAL COMPOSITION OF THE
HERBAGE OF ALFALFA, MEDIUM RED
CLOVER, LADINO CLOVER, BIRDSFOOT
TREFOIL, AND SMOOTH BROMEGRASS AT
VARIOUS STAGES OF MATURITY WITH
EMPHASIS ON MICRONUTRIENT ELEMENTS
AND AMINO ACIDS.

(Order No. 61-3136)

Gerald Milton Loper, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Dale Smith

Alfalfa, an alfalfa-bromegrass mixture, bromegrass, red clover, and ladino clover, harvested at Madison, Wisconsin, were analyzed for micronutrient element content. The effect of plant maturation on the concentration of iron, manganese, copper, cobalt, and zinc was determined on samples taken at 6 successive stages of growth during the spring growth periods of 1955 and 1956. Also, alfalfa harvested at 4 stages of growth in 1959, and alfalfa, red clover, ladino clover, and birdsfoot trefoil harvested at the 1/10 bloom growth stage during the spring growth periods of 1959 and 1960 were analyzed for total amino acids content.

The highest accumulation of micronutrient elements in pounds per acre generally was obtained at the mature growth stages. The legumes accumulated the highest amounts of all micronutrient elements except that bromegrass

accumulated the highest amounts of manganese. Generally, ladino clover was intermediate and bromegrass lowest in the accumulation of micronutrient elements.

The concentrations (ppm) of micronutrient elements generally decreased quite rapidly during the early stages of growth and then decreased more slowly at the mature stages. Major exceptions were the increases in the concentrations of manganese in bromegrass, and of zinc in red and ladino clover during the later stages of growth. Iron and cobalt decreased the most rapidly with maturity. The concentration of copper in bromegrass declined slowly and steadily with age and reached a very low level. Growing bromegrass with alfalfa (compared with bromegrass grown alone) reduced the manganese and increased the cobalt concentrations of the grass. No such effect was observed in the alfalfa.

Significant correlations between the concentrations of the micronutrient elements and the organic proximate analysis constituents previously determined on these samples were confined principally to positive correlations with protein and negative correlations with fiber. Correlations of the concentrations of the micronutrient elements with each other generally were positive and significant.

Alfalfa decreased in per cent dry weight concentration of 16 amino acids as it matured from pre-bud to full bloom. As a proportion of the total nitrogen, only glutamic acid increased as the alfalfa matured. The other amino acids decreased or fluctuated unsystematically.

Amino acid quality of the proteins in the herbage of ladino clover and alfalfa at the 1/10 bloom growth stage (compared by expressing the amino acid concentration on grams of amino acid per 16 grams of nitrogen) was superior to that of red clover and birdsfoot trefoil. On a per cent of dry weight basis, ladino clover and birdsfoot trefoil contained more of the essential amino acids than alfalfa and red clover. There was very little difference in total amino acid production on a pounds per acre basis among alfalfa, red clover, and ladino clover. Production of amino acids per acre by birdsfoot trefoil was much lower than the 3 other legumes due mostly to low dry matter yields.

The most nutritionally adequate herbage of the forages studied was obtained at the young stages of growth since the concentrations of some micronutrient elements (copper and cobalt) and amino acids (especially methionine, arginine, and lysine) were below adequate animal nutritional levels at the mature stages of plant growth.

Microfilm \$2.75; Xerox \$5.20. 105 pages.

HERITABILITY ESTIMATES AND RADIATION EFFECTS ON THE SEED SIZE COMPONENTS OF OATS

(Order No. 61-3045)

Charles Franklin Murphy, Ph.D.
Iowa State University of Science and Technology, 1961

Supervisor: Kenneth Frey

The primary components of grain yield, in oats, are the number of panicles per plant, the number of seeds per panicle and the mean weight per seed. The latter component was further subdivided into seed length, width and

density. To eliminate the effect of hulls which adhere to oat caryopses, the measurements were taken on dehulled seeds (groats). The groat measurements were taken for approximately 100 lines in the F₂ and F₃ generations in each of 12 crosses and for 300 to 500 lines in populations derived from radiated and non-radiated seeds of Bonham (large seeded) and C. I. 6748 (small seeded) oat varieties. In a companion study groat length and width were measured at regular intervals after anthesis.

Groat density was a constant value of 1.36 when the oat plants were not infected with disease. To avoid fluctuations in density due to environmental changes the groats were stored in a dryer for 72 hours prior to measuring density.

Mean heritability percentages (standard unit regression) for groat length, width and weight were 51, 35 and 36, respectively. The mean phenotypic and genotypic correlations between groat width and weight were 0.48 and 0.69, respectively, whereas similar values for groat length and weight were 0.36 and 0.49, respectively.

Groat length was found to be largely developed during an 8 day period following anthesis, while groat width required nearly three weeks from this date before development was complete. The correlations and lengths of developmental interval both suggested that width was more important than length in the determination of groat weight.

It is suggested that subdividing a quantitative character into components may cease to have analytical value when the components are developed during the same or overlapping periods of plant growth.

Groat weight, width and length appeared to be inherited as quantitative characters, but the genetic correlations between groat length and width (-0.09), indicated that different genetic systems affected these two components. A greater-than-average segregation for groat weight was found in two crosses. In both cases, groat weight segregation was due to an unusually wide segregation for only one of the components, length or width.

Radiation increased the variability of groat weight, length and width. Individual changes were generally small in magnitude and they occurred in both directions.

Microfilm \$2.75; Xerox \$3.00. 51 pages.

MINERAL AND ORGANIC FORMS OF NITROGEN IN SOME MICHIGAN SOILS AND AN AGRO-ECONOMIC EVALUATION OF THEIR POTENTIAL USEFULNESS FOR ADVISORY PURPOSES

(Order No. Mic 61-1197)

Bhubneshwar Narain Singh, Ph.D.
Michigan State University, 1960

Major Professor: A. R. Wolcott

Air-dry soil samples from five established field experiments were analyzed for exchangeable ammonium, nitrate, and two organic nitrogen fractions. These two organic fractions included the portion hydrolyzed by digestion with strong sulfuric acid and the portion resistant to acid hydrolysis. Attempts were made to correlate these measured forms of nitrogen with crop yields.

Ammonium levels in air-dry soils were several times higher than would be expected in field fresh soils, indicating release by breakdown of soil organic materials during storage. The quantities found were higher in soils high in total organic nitrogen than in soils low in organic nitrogen. There was no relationship to crop yields or to residual yield variance not explained by current fertilizer treatments.

Nitrate levels in soils sampled in the fall of the year reflected rotational differences and levels of previous nitrogen application. In soil samples taken in the spring, nitrate was low and unrelated to prior treatment. No correlation with crop yields or yield residuals was observed.

The two organic fractions and their total showed a tendency to increase with increasing level of nitrogen applied one year previously. However, these increases were not statistically significant. Where supplemental nitrogen had been applied on corn, beans and barley in a rotation including two years of alfalfa-brome, significant increases in each fraction and in their total were observed at the end of the first five-year rotational cycle. The increases in total organic nitrogen ranged from 352 to 648 pounds per acre, exceeding by a factor of 3 to 5 the 120 pounds total supplemental nitrogen which had been applied on the three crops preceding alfalfa. In a second experiment on the same soil type (Sims clay loam) where supplemental nitrogen had been applied on row crops and cereal grains over four cycles of two 5-year rotations, no significant increases in soil organic nitrogen were found. Residual organic nitrogen was significantly higher, by 400 pounds, in the livestock rotation which included manure and two years of alfalfa than in the cash crop rotation.

The ratio of nonhydrolyzable to hydrolyzable nitrogen varied under different systems of management. The proportion of nonhydrolyzable nitrogen was higher where alfalfa was included in the rotation, or where supplemental nitrogen was used. This effect of supplemental nitrogen was enhanced when combined with a high rate of application of other fertilizer nutrients.

In one experiment a maximum of 61 percent of yield variance was found to be associated with regression in a five-variable polynomial equation involving either total organic nitrogen or hydrolyzable nitrogen. However, most of the variance was associated with rotation or supplemental nitrogen treatments. A maximum of 26 percent of yield variance was associated linearly with total soil organic nitrogen when rotation, fertility level and supplemental nitrogen treatments were ignored. Only 15 percent and 5 percent of yield variance were similarly associated with hydrolyzable and nonhydrolyzable nitrogen, respectively.

Microfilm \$2.75; Xerox \$5.80. 118 pages.

THE MORPHOLOGICAL DEVELOPMENT OF SMOOTH BROMEGRASS UNDER CERTAIN SEEDING AND MANAGERIAL TREATMENTS

(Order No. 61-3166)

Gene Lyle Spain, Ph.D.
The University of Wisconsin, 1961

Supervisor: Associate Professor J. M. Sund

A wide range of management systems are employed with smooth brome grass (*Bromus inermis* Leyss) in Wisconsin, because it is used for pasture, hay, silage and green feeding. The maintenance of vigorous and productive brome grass in pure stands or in mixture with legumes is a difficulty common to most management systems. This problem prompted a study of the morphological development of the grass and of some of the associated responses of a brome grass-legume mixture under various seeding and managerial treatments.

Two studies of the morphological development of brome grass following seedling establishment were conducted at Madison, Wisconsin, beginning in the spring of 1955 and continuing until the summer of 1957. A uniform stand of a mixture of brome grass, alfalfa, and Ladino clover which had been seeded in 1954 was selected for Experiment A. The fertility treatments applied in 1955 were as follows: (1) no fertilizer, (2) 200 pounds of nitrogen per acre applied in the spring, (3) 400 pounds of nitrogen per acre -- 200 pounds in the spring and 200 pounds in the summer, (4) 600 pounds of nitrogen per acre -- 200 pounds in the spring, 200 pounds in the summer and 200 pounds in the fall, (5) 300 pounds per acre of 0-15-45 applied in the spring, and (6) 600 pounds of 0-15-45 per acre -- 300 pounds in the spring and 300 pounds in the fall. The following clipping treatments were superimposed upon each of the above fertility treatments: (1) clipped each time the brome grass was 6 inches high, (2) clipped each time the brome grass was 12 inches high, (3) clipped after heading of the brome grass and then each time it was 6 inches high, and (4) clipped once only when the brome grass was at the ripe-seed stage. Experiment B was established in May, 1955, when Lincoln and Canadian brome grass were broadcast and band seeded at 3 pounds and 6 pounds per acre alone and in mixture with alfalfa, Ladino, or red clover, and with and without a companion crop of oats.

Four brome grass plants were sampled at random from each plot during the first harvest year in each experiment. In the spring of the second harvest year of Experiment A, this same sampling technique was used, but on subsequent sampling dates, six plugs of sod 5 inches in diameter and 6 inches deep were taken randomly from each plot. In Experiment B, four plugs of sod of this same size were taken from each plot during the second harvest year. The following observations were made on each sample: Number, total length, and weight of rhizomes, number and weight of vegetative tillers, and number and weight of floral tillers. Yield and botanical composition data were collected throughout the trial.

Clipping only once during the season at the ripe-seed stage permitted much better brome grass development than did any of the other clipping treatments. Clipping the grass each time it was 6 inches high was the most severe treatment with respect to brome grass rhizome and tiller development and survival of the alfalfa. Clipping after heading

of the bromegrass and then at the 6-inch stages thereafter also was very damaging to the bromegrass and alfalfa. Although clipping regularly at the 12-inch stage of the bromegrass was not considered to be entirely satisfactory, it was less severe than the more frequent clipping treatments. The data suggest that delaying the first harvest until the bromegrass is headed and then harvesting each time the grass is approximately 12 inches high will maintain a desirable forage mixture and produce satisfactory yields.

Tiller development and forage yield of bromegrass were influenced by fertility treatments. The number and weight of tillers generally was increased by increasing rates of ammonium nitrate, while 0-15-45 had no important effect upon the tiller development of bromegrass. Similarly, forage yields were increased by ammonium nitrate, but not by 0-15-45.

Bromegrass developed a much larger and heavier rhizome system and more tillers of greater aggregate weight when grown alone or in association with Ladino or red clover than when grown with alfalfa. Differences in the development of rhizomes and tillers were not large among bromegrass plants grown alone or with Ladino or red clover.

Although individual plant response and yield differences indicated that Lincoln bromegrass was superior to the Canadian variety under the conditions of these experiments, differences between the two varieties were small when grown with alfalfa. Varietal differences, therefore, appear unimportant since alfalfa is generally included with bromegrass seedlings in Wisconsin.

The 3-pound rate of seeding bromegrass was satisfactory even under the very dry conditions during the establishment year (1955). A companion crop of oats did not materially affect morphological development of bromegrass but reduced total yields of forage. The band seeding method was superior to the broadcast seeding method with respect to rhizome and tiller development but yield differences owing to seeding methods were slight.

Microfilm \$2.75; Xerox \$7.40. 159 pages.

AGRICULTURE, PLANT PATHOLOGY

A STUDY OF CUCURBIT ANTHRACNOSE

(Order No. 61-3080)

Jay LaMar Anderson, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor J. C. Walker

Anthrachnose, incited by *Colletotrichum orbiculare* (Berk. & Mont.) v. Arx [syn. *Colletotrichum lagenarium* (Pass.) Ell. & Hals.] is an important disease of cucurbits in humid regions throughout the world. Watermelon varieties have been developed which are resistant to the common races of the fungus. A high level of anthrachnose resistance in pickling cucumber would also be desirable.

The objects of the present study were to study the inheritance of resistance of promising cucumber parental lines; to compare histologically the disease development

of races 1 and 2 of the fungus on resistant and susceptible watermelon seedlings and fruit; and to determine as far as possible the nature of resistance to race 1 in watermelon.

Progeny of a cross between the Plant Introduction No. 175111 of *Cucumis sativus* L. and Wisconsin SMR 12 cucumber variety showed an increased susceptibility to anthrachnose with each succeeding backcross generation. The resistance inherited from P.I. 175111 was shown to have, in addition to a dominant monogenic factor, modifying genes which influence the level of the resistant expression. In a straight backcross program these latter genes became so dilute that the resulting lines were hardly more resistant than the susceptible parent. The multigenic resistance of P.I. 163217 was shown to be of a higher level than that of P.I. 175111.

Watermelon varieties Dixie Queen and Peacock were susceptible to races 1 and 2, whereas varieties Charleston Grey and Congo were susceptible only to race 2. No difference in these susceptible reactions was detected. In susceptible tissue chloroplast containing cells were more sensitive to attack than nonphotosynthetic tissue and readily collapsed in the vicinity of the fungus. The mycelial strands had an affinity for vascular tissue and commonly grew through the phloem and sheath parenchyma parallel to the vein. Cell walls stained red with safranin and chloroplasts broke down in cells beyond the advancing hyphae.

Charleston Grey and Congo varieties were resistant to race 1. When infected they reacted with a collapse and break down of the infected epidermal cell or cells which resulted in death of the infecting hypha. The cells below the infected epidermis in leaf or fruit rind were stimulated to enlarge and divide. The chloroplasts broke down while the nuclei enlarged and remained active. A lens-shaped proliferation of compacted cells was formed below the infection site.

Detached leaves and excised rind of resistant plants became susceptible to race 1 when floated on water or sucrose solutions. Cells below the infection site proliferated in excised rind as in the intact fruit, but the fungus was able to break down this proliferation, ramify through the tissue, and sporulate. After a prolonged storage at 2°C resistant fruit became susceptible to facultative parasites to which they were normally resistant. Etiolation was also observed to increase susceptibility of resistant tissue to race 1. Resistance to Charleston Grey and Congo watermelons is apparently based on the metabolism of normally functioning leaf and fruit tissue. When various treatments slowed down or interfered with the normal metabolism of the plant, there was a tendency toward break down of resistance to race 1. Pectolytic enzymes were produced both in vitro and in vivo by both race 1 and 2. A toxin elaborated by the fungus may be operative in diseased tissue, but its presence was not demonstrated.

Microfilm \$2.75; Xerox \$3.60. 61 pages.

FACTORS AFFECTING THE PATHOGENICITY
OF PELLICULARIA FILAMENTOSA

(Order No. 61-3082)

Kenneth Reece Barker, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor J. C. Walker

The fungus *Pellicularia filamentosa* (Pat.) Rogers, imperfect stage *Rhizoctonia solani* Kühn, incites several types of diseases on crops throughout the world. It is known most commonly as a preemergence and postemergence damping-off parasite on crops such as bean and potato. The parasite also causes foliage and fruit diseases as well as considerable damage as a transit and storage pathogen.

The present study was initiated with the following objectives: 1) to determine the pathogenicity of various isolates on bean, potato, and other selected crop hosts; 2) to compare the disease development of selected isolates at different soil temperatures; 3) to study the histopathological development on different age bean seedlings with 3 strains of the parasite; and 4) to compare the relative pectolytic and cellulytic enzyme activity of various isolates with their pathogenicity and growth rates.

Twenty-eight isolates from various plants and locations were used in this study. Czapek's medium with 1 per cent pectin and an oat medium were used for growing the inoculum. The isolates were grown on the pectin medium for pectolytic enzyme assays and on Czapek's medium with 1 per cent methylcellulose for the cellulase assays.

The optimum soil temperature for disease development on bean varied from 16 to 28° C. Wisconsin isolates exhibited optima of 16 to 24° while North Carolina isolates had an optimum of 28°.

Strains from bean, potato and other hosts differed greatly in their pathogenicity on bean, potato, cabbage, beet, lettuce, tomato, and wheat. Most potato strains were not very pathogenic on any test host while the bean strains were more severe on bean and potato. Some strains attacked bean, potato, cabbage, and lettuce; others parasitized only 1 host; and some failed to incite disease on any host.

Beans became more resistant to the fungus with age. A bean strain infected young seedlings only. When beans were inoculated with a potato strain, the walls of the epidermal cells thickened which apparently prevented infection. Seedlings reacted hypersensitively to a cabbage strain which reduced the disease severity. This reaction was accentuated as the age of the plants at the time of inoculation increased.

All strains assayed exhibited polygalacturonase and pectinmethylesterase activity when grown on Czapek's medium with 1 per cent pectin as the carbon source. Highest polygalacturonase activity was obtained on culture medium with pH 4.0 while the highest pectinmethylesterase activity was found in culture medium with an initial pH of 7.0 which was the highest pH used. The optimum temperature for enzyme secretion, disease development and mycelial growth of a Wisconsin isolate was 24° while the optimum of a North Carolina isolate was 28°. Foliage strains were found to have higher pectinmethylesterase activity than root and stem isolates. A very high correlation ($r = 0.96$) was found between polygalacturonase activity of various isolates and their relative pathogenicity. With most isolates there was

a correlation between polygalacturonase activity and mycelial growth. Representative strains exhibited moderate cellulase activity. However, a high correlation between cellulase activity and pathogenicity was not evident. In fact 1 non-pathogenic strain gave higher cellulase activity than some highly pathogenic strains.

Microfilm \$2.75; Xerox \$4.80. 92 pages.

MECHANISMS OF FUNGITOXIC ACTION
OF n-DODECYLGUANIDINE
ACETATE (DODINE)

(Order No. Mic 61-882)

Irwin Frederick Brown, Jr., Ph.D.
University of Maryland, 1960

Supervisor: Dr. Hugh D. Sisler

In an homologous series of n-alkyl guanidine compounds with alkyl groups of 10-18 carbons, toxicity to *Saccharomyces pastorianus* and *Monilinia fructicola* was similar for homologues with alkyl groups of 11-16 carbons. The greatest toxicity toward the yeast was exhibited by the homologue with an alkyl group of 13 carbons whereas the homologue with an alkyl group of 14 carbons was most toxic to *M. fructicola*. Toxicity dropped off sharply with the homologues containing alkyl groups of 10 and 18 carbons.

No member of the homologous series of compounds was phytotoxic to the first true leaves of *Phaseolus vulgaris* var. Pinto, but severe injury was caused to the leaves of *Nicotiana glutinosa* by homologues with 10 or 11 carbons in the alkyl group. Phytotoxicity diminished as the number of carbons in the alkyl group of the homologues increased.

The hydrogen-ion concentration of the external medium affects the toxicity of dodine to cells of *S. pastorianus*. A 20 fold increase in the level of dodine was required to maintain a constant degree of inhibition (ED_{50}) when the pH of the external medium was lowered from 7.8 to 5.1.

Studies with ^{14}C labelled dodine indicated that this toxicant is rapidly accumulated in large quantities by the test organisms. In the first minute cells of *S. pastorianus* accumulated 85-90% of the total amount of toxicant ultimately taken up. These cells accumulated up to 18,300 μg of dodine per gram of fresh weight of cells in a fifteen minute period.

The inhibition, by dodine, of the oxidation of glucose by cells of *S. pastorianus* was closely correlated with the inhibition of growth of this organism. However, the effect of dodine on the oxidation of glucose by conidia of *M. fructicola* was not correlated with the effect of this compound on spore germination. A level of the toxicant which inhibited spore germination by 54%, actually stimulated respiration.

Fermentation of glucose was strongly inhibited in cells of the yeast which were pretreated with toxic concentrations of dodine or in cell-free extracts prepared from pretreated cells. Similarly, the fermentation of fructose-1,6-diphosphate (HDP) was strongly inhibited in cell-free extracts from pretreated cells. Under anaerobic conditions, pyruvate was not fermented by untreated yeast cells, but cells pretreated with dodine, readily fermented this substrate.

Cell-free extracts of the yeast metabolized pyruvate regardless of whether the extracts were prepared from untreated or from cells pretreated with dodine, although activity was less in the latter extract.

When HDP was the substrate, the activity of the enzyme aldolase was partially inhibited (66%) in cell-free extracts prepared from pretreated cells. However, no aldolase activity was detected in these extracts when glucose-6-phosphate was the substrate, although both substrates were metabolized in extracts from untreated cells. HDP was not fermented by untreated cells of this organism, but when the cells were pretreated with dodine, this substrate was readily metabolized.

Cells of *S. pastorianus* and conidia of *M. fructicola* lost phosphorus compounds and ninhydrin positive substances when treated with toxic doses of dodine. The loss of cellular constituents was considerably more prominent in the case of the former organism.

In both test organisms, dodine was more effective in preventing phosphorus uptake than in causing the loss of phosphorus compounds taken up prior to exposure to the fungicide.

Alteration of permeability of the cell with the resulting loss of vital cellular constituents, and inactivation of certain vital enzymes, appear to be the mechanisms by which dodine exerts its toxic effect on *S. pastorianus*. The toxicity of dodine to conidia of *M. fructicola* is attributed to the blocking of vital anionic sites in the cell surface and to the inactivation of certain vital enzymes other than those required in respiration.

Microfilm \$2.75; Xerox \$3.00. 57 pages.

PATHOGENICITY, LIFE CYCLE, AND MORPHOLOGY OF CERTAIN PRATYLENCHUS SPP. ON POTATO.

(Order No. 61-3094)

Ottie Joseph Dickerson, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Gerald Thorne

This study deals with (1) the pathogenicity and pathohistology of *Pratylenchus penetrans* (Cobb 1917) Filipjev and Stekhoven, 1941 on potato and corn, (2) influence of temperature and host on population increase of *P. penetrans*, (3) overwintering of *P. penetrans*, and (4) gonad development of *P. crenatus* (Loof 1960).

Pratylenchus penetrans and *P. crenatus* were found to be widespread in potato fields of Wisconsin. Only *P. penetrans* was associated with reduced yields. Neither soil type nor potato variety was found influencing population densities of *P. penetrans*. *Pratylenchus crenatus* was found in high populations only in sandy soils. In mixed populations 1 species was dominant.

Symptoms on plants growing in the field were generally limited to circular areas 30-150 ft. or more in diameter where plants were reduced in vigor, turned yellow and ceased to grow in the latter part of the season, had a reduced root system, and rendered lower yields.

Pratylenchus penetrans populations increased in roots, tubers, and soil as the growing season progressed. During

the fall and winter months the total population decreased and the percentage of adults increased.

Buried tubers harbored *P. penetrans* in limited numbers but they were not recovered from tubers stored over an extended period.

Symptoms expressed on potatoes at 24° and 28° C. in non-sterile *P. penetrans* infested muck in the greenhouse were essentially the same as those observed in the field. Symptoms other than a reduction of secondary roots were not expressed at 16° and 20° C.

Histological observations showed *P. penetrans* entered and fed in roots, rhizomes, and tubers. Penetration was direct. Only tissues centrifugal to the endodermis were affected. Damage appeared to be produced by direct feeding. Rhizomes were not as severely attacked as roots and the nemas were not found reproducing in tubers.

Corn root weights, stalk heights, and stalk diameters were reduced by *P. penetrans*. Plants were reduced more in Plainfield sand than in muck.

The optimum temperature for *P. penetrans* reproduction was 16° C. on potatoes and 24° C. on corn. Build-up was faster on corn than on potatoes.

Pratylenchus crenatus, a monosexual nema, was found to be a digonic hermaphrodite. Genital development was amphidelphic for a short period but only the anterior gonad developed into a functional organ.

There was considerable morphological variation between *P. penetrans* populations. These differences were not deemed sufficient to warrant designation as a new species.

Eight of 84 *Pratylenchus* spp. females of mixed ages reproduced when separately inoculated on various hosts. Four of 70 immature *P. penetrans* inoculated separately on peas reproduced. None of 55 single inoculations with immature *P. coffeae* reproduced on the same host.

The life cycle of *P. penetrans* may be completed within 35 days at 28° C. on peas.

Attempted matings of *P. coffeae* and *P. penetrans* were unsuccessful. However, there was the possibility of host influence since *P. coffeae* did not thrive well on peas.

Microfilm \$2.75; Xerox \$3.80. 66 pages.

EFFECT OF CAPTAN AND CAPTAN-DIELDRIN ON GERMINATION AND YIELD OF WHEAT

(Order No. 61-3010)

Ofelio Rivera Exconde, Ph.D.
Kansas State University, 1961

The objectives of the study were to determine (1) the responses of 8 winter wheat varieties to seed treatments by captan and captan-dieldrin, (2) the effect of captan and captan-dieldrin on emergence and yield of wheat seed having different ranges of seed germination, and (3) the fungi associated with these seed lots in Kansas.

The 8 varieties used were: Comanche, Pawnee, Wichita, Triumph, Kiowa, Ponca, Concho, and Bison. Four germination ranges, based on laboratory germination percentages of seed, were included: 96-100, 91-95, 86-90, and 81-85. These ranges were designated respectively as ranges 1, 2, 3, and 4. The seed was treated with captan and captan-dieldrin, both at the rate of 1 ounce technical captan per

bushel. The experimental design was randomized blocks replicated 3-5 times. In the field 200 seeds were planted per 12-foot row. Emergence counts were made when wheat plants were at the 2-leaf stage. Plants were harvested after they were completely ripe and dry and then threshed in a nursery thresher. Emergence and yield were analyzed statistically.

In determining the microflora of wheat seed, slightly more than 100 seeds were surface-sterilized 1 minute in 70 percent ethyl alcohol and then 1 minute with 1 percent sodium hypochlorite solution. They were plated out on previously acidified sterile potato dextrose agar. Records were kept of the fungi that grew out from the seed.

The varietal mean emergences in the 1958, 1959, and 1960 crops were respectively 70.8, 61.9, and 79.5 percent for no treatment, 77.2, 72.8, and 79.4 percent for captan, and 81.5, 72.2, and 80.4 percent for captan-dieldrin. No significant interactions were obtained between varieties and treatments.

The varietal mean yields in bushels per acre in the 1958, 1959, and 1960 crops were respectively 14.6, 24.6, and 21.9 for no treatment, 15.9, 27.0, and 22.4 for captan, and 18.4, 26.8, and 22.5 for captan-dieldrin. No significant interactions were obtained between varieties and treatments.

The comparative efficacies of the treatments with respect to emergence and yield showed that captan and captan-dieldrin were significantly better than no treatment both in the 1958 and 1959 crops, but not in 1960. Captan-dieldrin was superior to captan only in 1958.

The correlation between emergence and yield showed that emergence of plants indicated only a fair measure of predicting yield.

Treatments of wheat seed having different ranges of seed germination with captan and captan-dieldrin showed that increases in emergence in range 4 were considerably greater compared to increases in emergence in ranges 1, 2, and 3. For the 3 crops, no significant interactions were obtained between treatments and ranges.

In the 1958 and 1959 crops, but not in 1960, increases in yield were obtained from both treatments in all ranges of seed germination. Increases in yield from both treatments were much greater in range 4 than in ranges 1, 2, and 3. For the 3 crops, no significant interactions were obtained between treatments and ranges.

Different kinds of fungi were associated with wheat seed, with *Alternaria tenuis* the most common. The amount of seed infected with *A. tenuis* in 1957, 1958, and 1959 seed lots was respectively 39.4, 53.5, and 41.7 percent. Among the pathogens, *Helminthosporium sativum* was predominant. The amount of seed infected with *H. sativum* was 13.2 percent in 1957, 1.0 percent in 1958, and 0.5 percent in 1959 seed lots.

The greater responses to the treatments in the 1958 crop compared to the 1959 and 1960 crops probably were due to the higher amount of seed infected with *Helminthosporium sativum*.

Microfilm \$2.75; Xerox \$5.00. 96 pages.

INVESTIGATIONS OF OAK WILT AND OF
MAPLE BLIGHT: I. THE EFFECTS OF
TEMPERATURE AND MOISTURE ON THE
DEVELOPMENT OF OAK WILT.
II. THE DEVELOPMENT OF OAK WILT IN
BUR OAK (*QUERCUS MACROCARPA* MICHEAUX).
III. THE ETIOLOGY OF THE MAPLE BLIGHT
DISEASE OF SUGAR MAPLE
(*ACER SACCHARUM* MARSHALL).

(Order No. 61-3117)

David Royce Houston, Ph.D.
The University of Wisconsin, 1961

Supervisors: Associate Professor James E. Kuntz and
Professor A. J. Riker

I. The Effects of Temperature and Moisture on the Development of Oak Wilt. -- With constant and equal soil and air temperatures, wilt percentages of inoculated Chinese oak seedlings increased from 50% at 20°C to 100% at 28°C. Incubation periods averaged 16 and 9.3 days respectively. None wilted at 16, 32, or 36°C (within 20 days). With constant, but differing soil and air temperatures, symptoms were influenced more by air than by soil temperatures. Intermediate temperature combinations gave intermediate wilt percentages. Symptoms developed with or following transpiration decline. Growth of *Ceratocystis fagacearum* after 10 days on agar was best at 24, poor at 16 and 32, and nil at 36°C. In full sunlight, temperatures of 32°C or above developed readily in northern pin, and less readily in bur oak logs; also occasionally in northern pin but not in bur oak trees. In field plots, only 1 of 9 young red oaks developed symptoms when moisture was practically excluded for 2 weeks before and 1 week after inoculation. But 11 of 12 such oaks developed symptoms on an adjacent, heavily watered area.

II. The Development of Oak Wilt in Bur Oak (*Quercus macrocarpa* Micheaux). -- Certain factors affecting disease development were studied. Infection in hot, dry periods of 1955 was low compared to that in cool, wet periods of 1956 and 1957. Also, the rate of disease development in 1955 was slow compared to that in 1956 and 1957.

For each year, high infection followed inoculations in May through early July, while low incidences followed inoculations in late fall and early spring. Symptom development was fastest in late spring and early summer and decreased thereafter. Thus, environment influenced disease development.

Tree size had no effect on disease incidence, and only temporarily affected disease severity. Recovery in subsequent years was related to degree of infection the year of inoculation. More lightly infected trees recovered than did trees heavily infected.

III. The Etiology of the Maple Blight Disease of Sugar Maple (*Acer saccharum* Marshall). -- Maple blight, first reported in 1957 in northeastern Wisconsin, caused deterioration and mortality of sugar maples growing in mixed northern hardwood forests. Variable insect defoliation of maples had occurred for 1 to several years prior to the appearance of the disease, although the role of defoliation in maple blight was not known.

The disease was severe in 1956 and 1957 in areas

defoliated previously by insects. Generally, affected trees have shown continuing recovery since 1958.

Primary symptoms included dead terminal buds and twigs; small, sparse, chlorotic foliage; formation of branch and bole sprouts; and sometimes death.

Inoculations with representative fungi and bacteria recovered from diseased trees, and mechanical transmission tests for viruses failed to produce maple blight symptoms.

Typical symptoms developed the year following mechanical defoliation of maple saplings; were restricted to those branches that were defoliated; and were especially severe on saplings defoliated from mid-July to mid-August.

Tissues which refoliated the year of defoliation were susceptible to damage by local fall frosts. Thus, saplings defoliated in exposed areas suffered more damage than did saplings protected by dense over-stories.

Defoliated saplings which died appeared associated with adjacent stumps or previously dead trees and saplings and were attacked by root rot fungi, especially *Armillaria mellea*. Also, stumps of blighted trees were attacked more frequently and to a greater extent by *A. mellea* than were stumps of nonblighted trees.

Microfilm \$2.75; Xerox \$8.60. 187 pages.

SOME STUDIES ON THE ASTER-YELLOWS VIRUS AND TRANSMISSION BY THE SIX-SPOTTED LEAFHOPPER *MACROSTELUS FASCIFRONS* (STÅL.).

(Order No. 61-2967)

Peter Elliot Lee, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor R. Keith Chapman

The aster-yellows virus transmitted by *Macrosteles fascifrons* (Stål.), the six-spotted leafhopper, is a typical example of a virus which multiplies in its vector, the latter remaining infective for life under natural conditions.

This paper reports studies on: some aspects of field transmission, differentiation of aster-yellows isolates, relative efficiencies of various inoculation and acquisition feeding periods, the effect of temperature on transmission, and partial purification of the virus.

The incidence of aster yellows at Kenosha, Madison, and Rhinelander, Wisconsin, was low during 1958 and 1959. No clear pattern of field infection occurred, although the trend at Kenosha for 1958, and 1959 was somewhat alike, with mid-season peaks in both years. Leafhoppers collected in the same areas indicated a very low percent of viruliferous insects.

Two aster-yellows isolates were separated on their ability to infect celery--a celery-infecting isolate (Wis. CAYV), and a non-celery infecting isolate (Wis. NCAYV). Periwinkle and *Nicotiana rustica* plants infected with CAYV, produced symptoms similar to eastern aster yellows. Western aster-yellows symptoms were produced in periwinkle plants infected with NCAYV. Zinnia plants infected with the celery isolate produced both eastern and western aster-yellows symptoms.

The relative efficiencies of inoculation and acquisition feeding times from 0.125 to 32 hours by single insects were studied. Data were exponential for inoculation

feeding. The (r) value of a regression line calculated from observed results was 0.973, indicating high linear correlation between percent transmission and inoculation time. No transmission occurred when insects were given acquisition periods of less than 2 hours. Between 1 and 16 hours, acquisition was exponential, but less so between 16 and 32 hours. The acquisition threshold between 1 and 2 hours suggests that acquisition of aster yellows by the leafhopper is more critical than its inoculation.

Temperature studies on the transmission of the celery-infecting isolate of aster yellows, showed that acquisition periods of 1 day at 32°C. and 36°C. did not affect the ability of small leafhopper colonies to acquire virus, or affect the initial phase of virus incubation in the vector. But the transmission of virus by colonies similarly treated at 40°C. was affected. When colonies were heated to 40°C. for 1 day prior to acquisition on aster source plants at 25°C., transmission was not affected. Similar heat treatments of source plants immediately before allowing colonies to acquire virus, did not prevent acquisition. Eight-hour acquisition periods at 40°C. although not affecting the ability of colonies to acquire virus, resulted in lengthened incubation periods.

Transmission of colonies given 1 day acquisition feeding at 25°C. then exposed to 32°C., 36°C., and 40°C., was affected. Exposures to 32°C. and 36°C. for 10 days lengthened incubation, but transmission occurred eventually, except in 2 colonies (one held at 32°C., and one at 36°C.). No transmission occurred when colonies were heated for 5 days at 40°C., indicating that most, if not all of the virus was inactivated.

The ability of viruliferous colonies to transmit was not affected by 10 or 13-day exposures at 32°C. But 10-day treatments at 36°C. of viruliferous colonies resulted in inconsistent transmission. Viruliferous colonies heated for 5 days at 40°C., regained their ability to transmit within 18 days.

These data indicate that the thermal inactivation point of the celery-infecting isolate of aster yellows in the vector, is higher than that of isolates of the same virus previously studied, and temperature therefore may be useful in the separation of strains of this virus.

Results of purification experiments were inconsistent. Slight indication was obtained by injecting and feeding non-viruliferous leafhoppers, that virus stabilization may occur with the addition of sodium thioglycolate, and sodium diethylthiocarbamate to plant extracts; and that the shape and size of the particle was spherical with a diameter of 35-40 mu. Microfilm \$2.75; Xerox \$4.80. 94 pages.

THE EFFECT OF *USTILAGO TRITICI* (PERS.) ROSTR. ON THE GROWTH AND MORPHOLOGICAL CHARACTERS OF WINTER WHEAT.

(Order No. 61-3014)

Satish Chandra Mathur, Ph.D.
Kansas State University, 1961

Although loose smut is an important disease in Kansas and other wheat growing regions of the world, little work has been done previously to study the influence of *Ustilago*

tritici (Pers.) Rostr. on the growth and morphological characters of wheat.

The influence of race 11 of *U. tritici* was studied on winter wheats Bison and Marquillo-Oro x Early Blackhull Hybrid in field trials during 1957-60. Four characters, namely, number of tillers, length of peduncles, length of rachises, and height of plants were studied in four experiments, (1) different dates of planting, (2) 1 1/2- and 3-in. seeding depths each with 2- and 4-in. spacings, (3) application of nitrogen at the rate of 50 lb. per acre and (4) application of P₂O₅ at the rate of 80 lb. per acre. Randomized Block design was used in laying out the experiments. Six to 8 rows each 16 ft. long were replicated 4 times for each treatment. Data were based on 6,836 healthy and 4,464 smutted plants.

Due to the presence of *U. tritici* in the embryonic tissues the germination and emergence of infected seed was reduced by 12.5 percent. A two-year study indicated that emergence of seedlings was slowed down, as evidenced by the low emergence on the first day and a day's delay in the peak emergence. The susceptibility of the seedlings to winter-killing was increased by 24.1 percent in Bison and 39.2 percent in M-O x EB.

The first spikes of the smutted plants emerged one day later than the healthy ones. The slow emergence of smutted spikes was evident by 2 day's delay in peak emergence.

The growth of the smutted plants prior to the emergence of spikes was similar to that of the healthy ones but was characterized by sudden slowing down and stoppage of growth soon after the emergence of spikes while the healthy plants continued their growth. This was due principally to the fact that after emergence peduncles of smutted plants grew for only 5 days whereas healthy peduncles continued growth for 9 days. Lack of cell elongation was the main cause of stunted growth of the smutted peduncles.

The smutted plants produced 44.9 percent fewer tillers than the healthy ones and this reduction varied from 31.9 to 56.3 percent when plants grew under different dates of planting, seeding depths and spacings and separate applications of nitrogen and phosphorus fertilizers.

Most smutted plants had 5 but a few had 4 visible nodes. The reverse was the case in healthy plants. The first 2 internodes below the peduncles were respectively 17.4 and 17.8 percent longer in smutted plants than in healthy ones which is a unique effect of *U. tritici*. The smutted peduncles and rachises, however, showed 49.5 and 21.5 percent reductions in their length, respectively. Smutted plants were 19.0 percent shorter than the healthy ones. Reductions in the length of smutted rachises varied from 14.5 to 29.5 percent; however, reductions in the length of peduncles and height of smutted plants did not differ much under conditions of different dates of planting, 1 1/2- and 3-in. seeding depths, 2- and 4-in. spacings and separate applications of nitrogen and phosphorus fertilizers.

Microfilm \$2.75; Xerox \$7.60. 161 pages.

DOWNY MILDEW OF SOYBEANS

(Order No. 61-3047)

Vernyl Duwaine Pederson, Ph.D.

Iowa State University of Science and Technology, 1961

Supervisor: John M. Dunleavy

Systemic infection of soybeans by *P. manshurica* (Naom.) Syd. ex Gaum. was obtained by inoculating seeds with oospores from encrusted seeds or diseased leaf material. A higher percentage of systemic infection was obtained when seed coats were removed prior to inoculation, than when they were left intact. A higher percentage of systemic infection resulted when inoculated seeds were germinated at 15 and 20 C than at 25 and 30 C. The highest percentage of seedlings became systemically infected when activated charcoal mixed with oospores was used as inoculum.

Conidia remained viable at least 19 days stored aerobically or anaerobically in water at 1 C and at least 14 days stored intact after sporulation on leaves at -14 and 1 C.

Percentage germination of conidia was inversely proportional to their concentration on the surface of water agar. The adverse effect of high concentration on germination was due to an inhibitor associated with conidia. The inhibitor diffused readily in water and was lost from aerated suspensions, but was retained in suspensions stored anaerobically.

Illini soybean seedlings infected with *P. manshurica* were exposed to daily light durations of 6, 12 and 18 hours. Size of unifoliate leaves, duration of sporulation, and number of conidia per unit area of infected leaf surface were directly proportional to light duration. The percentage of leaf area infected was inversely proportional to light duration. Oospores in infected leaf tissue developed simultaneously with the onset of chlorosis. They developed earlier and in greater numbers under short light periods than under long light periods.

The effects of environmental conditions on sporulation, conidial discharge and infection under field conditions were studied by determining the amount of infection which developed on soybean seedlings exposed to downy mildew in the field. The environmental factor most influential in determining success of secondary infection was duration of dew. Heavy sporulation was favored by a ten-hour period of heavy dew. Peak conidial discharge occurred concurrently with rapid drying of field plants. Conidia discharged during the morning hours caused infection the following night provided conditions for conidial germination were favorable.

Microfilm \$2.75; Xerox \$6.40. 133 pages.

STUDIES ON THE POPULATION DYNAMICS
OF SEVERAL FUSARIA IN THE SOIL
AND PLANT RHIZOSPHERE

(Order No. 61-3156)

Andres A. Reyes, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor J. E. Mitchell

The population dynamics of *Fusarium solani* f. *pisi* (F. R. Jones) Snyder & Hansen, *F. oxysporum* f. *lycopersici* (Sacc.) Snyder & Hansen, and *F. solani* (Mart.) Appel & Wremend Snyder & Hansen in unplanted soil and in plant rhizospheres as influenced by soil environment, different species of plants, and other factors was investigated. The population of *Fusarium* in soil samples was determined by a dilution plate technique. Only 30% of *F. solani* f. *pisi* was recovered by the method immediately after adding the inoculum to the soil. Eight days after introduction, the population of this fungus reached a peak in the soil, and then declined. The early increase in population was affected by several factors including 1) food base in the soil, 2) destruction of soil mycotoxin, and 3) initial level of population.

The population of *Fusarium* was stimulated in the rhizosphere of susceptible plants but not in that of nonhost plants representing several families. It could not be detected by direct microscopic observation whether spore or mycelial reproduction of *Fusarium* was stimulated in the rhizosphere. Stimulation of *F. solani* f. *pisi* was evident in a zone within 2 mm of the roots of susceptible pea and was more intense around the younger portions of the root. This stimulation occurred around the roots of plants growing in soil but not in sand.

Only in the rhizosphere of the genus *Pisum* was there stimulation of *Fusarium solani* f. *pisi*. This effect was evident in the rhizosphere of *P. sativum* L. but the levels of the fungus population in the rhizosphere of different varieties and individual plants differed. The rhizosphere effect of *P. sativum* was evident as early as 4 days after planting, reached a maximum on the eighth day, and was still noted after 64 days. This stimulation was not evident in the plant rhizosphere in the presence of the native fungus population but stimulation did occur where only fungal and bacterial contaminants from the air were present.

Equal stimulation of *Fusarium solani* f. *pisi* occurred in the rhizosphere of peas grown in loam, muck and compost but none was evident in loam soil diluted with sand. No stimulation occurred in the rhizosphere of peas grown in soil with 4% moisture. The stimulation was not correlated with the pH of the soil in the pea rhizosphere. The stimulation of the fungus in the rhizosphere was apparent at 20°C but not at 16° or at 24°. At 28° the roots were severely diseased and the high population of the fungus was probably a reflection of the "saprophytic potentialities" of the fungus. There was no stimulation of the fungus in the rhizosphere of pea plants grown continuously in the dark or grown in leached soil. There were differences in the degree of response in the pea rhizosphere among 4 sister isolates of the fungus.

Microfilm \$2.75; Xerox \$6.20. 130 pages.

BIOLOGICAL ASSAY, PURIFICATION,
MORPHOLOGY AND BIOCHEMICAL
PROPERTIES OF THE WISCONSIN
PEA STREAK VIRUS.

(Order No. 61-3159)

Eugen Emil Rosenkranz, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Donald J. Hagedorn

Chenopodium amaranticolor Coste & Reyn. was found to be a satisfactory local lesion host for the biological assaying of WPSV at dilutions from 10^{-2} to 10^{-3} . The half-leaf technique can be used to advantage and the plant is particularly suitable for the latin square design. The leaves of this plant remain susceptible to WPSV for a long time, the center leaves giving the most uniform results. Lesion counts can be made 5-7 days after inoculation.

The inoculum, derived from peas, is most infectious when it is prepared with distilled water. The dilution-end point of WPSV from pea is 10^{-6} . Dusting the leaf surface of the assay plant with Carborundum increased the lesion number 15 to 20 fold in subsequent inoculations. Application of inoculum with a brush gave better results than when a cheese cloth pad, glass spatula, or forefinger were used. The lesion number formed per leaf could be enhanced by repeated wipings of the leaf blade with an inoculation pad. Washing of inoculated leaves decreased the number of lesions developing.

The number of local lesions formed was greatest at 16°C and decreased steadily as the temperature was raised by increments of 4 degrees up to 28°C. For each rise in temperature, the incubation period decreased by about 24 hours and the lesion size increased by roughly 1/64 inch in diameter. Darkening assay plants for 24-48 hours prior to inoculation increased the lesion number considerably. Post-inoculation darkening decreased the number of primary lesions which developed. Test plants exposed to a photoperiod of 9 hours immediately following inoculation, produced more lesions per unit area than when receiving 3, 6, or 12 hours of illumination. A daylength of 9 hours during the entire incubation period resulted also in the production of more lesions than 6 hours' or 12 hours' duration of light. The lesion number per leaf on inoculated test plants held at 350-400 foot candles was greater than on plants kept at 150-200 f.c. Results from nitrogen nutrition experiments with *C. amaranticolor* in relation to the formation of local lesions were inconsistent. Some vague correlation between raised levels of nitrogen supplied to the plants and increased numbers of lesions was observed, but the exact optimum amount of the nutrient element could not be determined.

A few variables affecting WPSV-concentration in *Pisum sativum* were studied. Three to four weeks after inoculation the pea plants contained 2-2½ times as much infectious virus as either two weeks or six weeks after inoculation. Roots of infected pea plants yielded at least as much active virus as leaves, but stem tissue contained more infective WPSV than either roots or leaves. The concentration of WPSV in systemically infected peas rose steadily from the 4th to the 16th day following inoculation at all four temperatures (16, 20, 24, 28°C) tested. The most conducive temperature for virus multiplication and accumulation within the pea plants was 20-24°C.

WPSV is most stable at pH 6.1-6.2 (the value for pea homogenates), slightly less so at pH 7.0. The virus will tolerate a pH range from 4 to 10.

Experiments were conducted to develop a satisfactory purification procedure for WPSV, one which would yield virus preparations of high purity, maximum infectivity and relatively low degree of aggregation. Neither of the several purification methods initially tried - salt precipitation, freezing of tissue plus centrifugation, chloroform and/or butanol emulsions, heat coagulation, ethanol denaturation - satisfied these requirements to any practical extent. However acidification (pH 5.0) of the filtered homogenate from pea, followed by 1 - 1.5 hours incubation at 24-25°C and subsequently by three cycles of differential centrifugation, yielded very pure preparations of relatively high infectivity. Less aggregation of the virus particles in the final concentrates occurred when the virus was suspended in 0.02M borate (pH 6-8) buffer than in either distilled water or phosphate buffers of different molarities, but completely monodisperse virus suspensions could not be obtained.

In electron micrographs particles of WPSV were 12-14 mu wide and had a mean length of 586 ± 29 mu. Calculation of the dimension of Dow polystyrene latex spheres revealed that the diameter of these varied substantially. The sedimentation coefficient for WPSV was computed to be 136-137S. Purified concentrates of WPSV contained about 15.5% nitrogen and 0.53% phosphorus. On that basis the calculated nucleic acid content in WPSV was 5.4%.

Microfilm \$2.75; Xerox \$9.25. 205 pages.

STRAWBERRY MULTIPLIER DISEASE IN WISCONSIN

(Order No. 61-3163)

Om Parkash Sehgal, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor D. M. Boone

A diseased condition in cultivated strawberry varieties known as "multiplier" disease has been recognized in northern Wisconsin for the last thirty years. The affected plants are distinctively stunted and bushy, symptoms that are markedly different from those of other commonly prevalent strawberry virus disorders. The purpose of the present investigation was to ascertain the etiology of the multiplier disease and to study some of the physiological changes in plants in relation to the disease development.

Strawberry multiplier disease was established to be of

virus nature. The causal virus was repeatedly transmitted through leafgrafts and dodder, *Cuscuta subinclusa* Dur. and Hilg. The virus could be transmitted only to *Fragaria* spp. All cultivated varieties were found to be susceptible. *F. chiloensis* (L.) Duchesne and *F. orientalis* were found to be good indicators of the disease.

Alphis forbesi Weed, *A. gossypii* Glover, and *Macrosteles fascifrons* Stal did not transmit the disease. It was not transmitted through the soil. Attempts to mechanically transmit the strawberry multiplier, mottle, and vein-banding viruses to several rosaceous and nonrosaceous plants were unsuccessful.

Strawberry multiplier disease resembles in symptomatology the "stunt" and "witches' broom" diseases. The virus was distinguished from that of aster yellows in strawberries by its nontransmission through dodder to aster, periwinkle, and other differentials of the aster yellows virus, and by nontransmission by the aster leafhopper, *M. fascifrons*.

Infected plants showed symptoms suggestive of interference in the normal balance of growth substances. However, no free auxin or other *Avena* sensitive indoles were detected in roots, leaves, and crowns of disease-free and infected *F. vesca* L. (East Malling clone) plants. Foliar applications of indole-3-acetic acid and gibberellic acid did not produce any direct effect on symptom expression, indicating that, in spite of the additional supply of growth promoting substances, the stunting principle in diseased plants was still operative.

An unknown compound which gave positive chromogenic reactions with Salkowski's and Ehrlich's reagents and with 2 per cent ethanolic ferric chloride was detected in ether extracts of the roots, leaves, and crowns of *F. vesca* (EMC) plants. Its concentration in plant tissues was not altered by virus infection. The exact identity of this compound was not determined.

Analysis by paper chromatography of amino acids in the leaves of disease-free and infected *F. vesca* (EMC) plants showed some consistent differences. A marked increase in the concentration of asparagine in the diseased leaves was observed, and its accumulation was found to be in direct relation to the progression of disease symptoms in the plants. Phenylalanine in the free form was detected in the chronically affected leaves only. The concentration of protein amino acids in infected leaves was relatively lower than in disease-free leaves. Protein amino acids in leaves were found to be present in amounts eight to nine times greater than free amino acids in the same tissues.

In the strawberry variety Siletz a greater build up of asparagine and glutamine was observed in chronically affected leaves than in the disease-free leaves. Pipecolic acid in the free form was detected in infected leaves only.

Microfilm \$2.75; Xerox \$5.20. 104 pages.

ANATOMY

THE EARLY POSTNATAL DEVELOPMENT OF THE CEREBELLAR CORTEX IN THE DOG AND THE EFFECT OF EARLY SPINOCEREBELLAR TRACTOTOMY

(Order No. 61-2926)

Lois Claire Perkins, Ph.D.
Duke University, 1961

Supervisor: Talmage L. Peele

The normal development of the cerebellar cortex was studied in forty-eight dogs ranging in age from newborn to three months. This development was found to be essentially equivalent to that reported for other mammalian species, and to be uniform in all areas of the cerebellum.

During the first postnatal week the rate of migration of cells from the outer granular layer overcomes the growth rate of the individual cells, and the layer becomes steadily reduced in thickness until its final disappearance at nine weeks. At birth the migrating cells are apparently all of the rounded or ovoid type which will become granule cells, but by three days spongio-

blasts, the forerunners of Bergmann cells, are seen in the molecular layer.

The basket cell axons form their baskets around the Purkinje cells during the second postnatal week, just before the puppies begin to walk. The Purkinje cell dendrites do not penetrate into the outer granular layer, reaching the surface only after the final disappearance of this layer.

In an additional sixteen dogs lesions were placed in the lower thoracic spinal cord at six to eight days after birth to remove some of the afferent impulses to those areas of the cerebellum generally considered to receive connections from the hind limbs. These lesions all included at least the dorsal spinocerebellar tract, unilaterally or bilaterally. Two dogs had unilateral hemisections, three had bilateral hemisections one to five segments apart, and in one dog a complete transection was done.

Despite these lesions the cerebellar cortex showed normal development. The cervical spinal cords of all experimental animals appeared normal when sectioned and stained with luxol fast blue and cresyl fast violet.

It is concluded that the number of afferent connections removed by these lesions was insufficient to disturb the normal development of the cerebellar cortex.

Microfilm \$2.75; Xerox \$3.00. 58 pages.

ANTHROPOLOGY

THE ANATOMY OF A TRADITION: A STUDY OF SOUTHEASTERN STAMPED POTTERY.

(Order No. Mic 60-6300)

Edward Vance McMichael, Ph.D.
Indiana University, 1960

The tradition, defined as "a cultural continuity through time," is currently a much used concept in archeology. The present study endeavors to examine in extensive and intensive detail, just one tradition, and from such a study, attempt to better understand what a tradition is, and its value to archeology. The tradition studied consists of pottery stamped by a carved paddle, which prehistorically, is found mainly in the Southeastern portion of the United States. This tradition in turn is subdivided into three sub-traditions: simple stamped pottery, that showing straight line stamping, a result of a simply grooved paddle; check stamped, having a grid design, and produced by cross-hafted paddles; and complicated stamped, or pottery having complex stamped designs, resulting from

intricately carved wooden paddles. Each sub-tradition in turn was divided into modes or substyles within the three technics.

In order to adequately document this tradition, areally, temporally, and quantitatively, the writer used what is termed a "historical-geographic" method, with cartographic supplements. This amounts to dealing with each time level of the sub-traditions individually, plotting that time level's distribution in space, and providing "isoceramo-bars" to indicate quantitative areal dispersement. Thusly, each sub-tradition was studied independently on the basis of all available pertinent data in the Southeast and adjacent areas, resulting in an atlas of 15 maps detailing the quantitative historical-geographic development of the three sub-traditions.

Simple stamping occurs first, about 1000 B.C., a result of stimulus diffusion from the Northern Woodlands, climaxes early, and then persists and spreads up to the Historical period. Simple stamping in the Historic period is found sporadically over much of the eastern United States. Its greater spread is due to its greater antiquity, as well as "effective" similarity to other Woodland pottery technics.

Check stamping appears about 500 B.C., and it also sees an early climax, and considerable spread. However, with the introduction of complicated stamping, about 1 B. C., check stamping declines, but persists, to see another intensive climax in the Early Mississippi period on the Southeastern Littoral, then again declines. Check stamping in the Historic period is also scattered over the eastern portion of the United States, usually a lesser partner to simple stamping.

Complicated stamped pottery originates through the Crystal River Complex intrusion from Coastal Mexico, bringing the idea of complicated stamping, which is adapted to pottery by the native Deptford peoples of the Georgia-Northwest Florida Coastal Plain. An early climax of the technic is seen in Early Swift Creek, and a later one in upland Georgia in Early Mississippi (Etowah), and another in Lake Mississippian Lamar.

The study then shows the origins, development and diffusion of the stamped pottery tradition. Certain particular historical conclusions are possible, as well as the formulation of hypotheses regarding cultural dynamics.

Cultural complexes are seen as occurring as symmetrical curves in space, and as skewed curves in time: if a culture is dynamic, then the skew is to the early end of the temporal continuum; if the culture is conservative, then to the late end of the continuum. The age-area concept, and other distributional concepts exant in ethnology are re-examined for validity; ethnic carriers of the tradition appear to be both Cherokee and "older" Muskogean in the main, but the trait has frequently crossed ethnic lines.

In short, this one tradition has been dissected, and from the exposed anatomy of this one example, generalizations have been derived. But to adequately test the writer's formulations, other similar studies are needed.

Microfilm \$3.15; Xerox \$11.05. 244 pages.

THE PUEBLO INDIAN OCCUPATION OF THE SOUTHERN GREAT BASIN

(Order No. 61-2994)

Richard Shutler, Jr., Ph.D.
University of Arizona, 1961

Supervisor: Emil W. Haury

Beginning in the 1920's, and lasting into the late 1930's, excavation of Pueblo sites along the Lower Muddy River was carried on under the sponsorship of the Museum of the American Indian, Heye Foundation, Southwest Museum, and National Park Service. All or portions of 121 Houses (Sites) were excavated. The sites are composed of pit-houses, pueblos, and combinations of the two types of dwellings.

To illustrate the pattern of Pueblo land use the southern Nevada Pueblo region has been divided into two areas: The Area of Farms and Villages, and the Area of Hunting and Trading.

Analysis of the architecture, material culture, and burials indicates an occupation by the Basketmaker-Pueblo people of the Lower Muddy-Virgin river area from 300 B.C. to A.D. 1150. This time span which is best documented at Lost City is divided into four phases: the Moapa Phase, 300 B.C. to A.D. 500; the Muddy River Phase, A.D. 500 to 700; the Lost City Phase, A.D. 700 - 1100; the Mesa House Phase, A.D. 1100 to 1150.

The Southern Paiute entered southern Nevada sometime during the Lost City Phase. There is no doubt as to the joint occupation of this region by these two cultures representing different cultural patterns.

The Pueblo people practiced agriculture by farming the river bottoms of the Muddy and Virgin rivers. Close relations are indicated with the people of the Upper Virgin River area. This region of the Muddy-Virgin rivers is called the Virgin Branch of the Anasazi Culture, and is defined in this report.

The reason for abandonment of the area by the Pueblo people does not seem to be a climatic change. Competition for the land by the Pueblo and Southern Paiutes appears to be a strong possibility.

Microfilm \$6.80; Xerox \$24.10. 535 pages.

ASTRONOMY

ON THE SOLAR SPECTRUM FROM 2285 Å TO 3000 Å

(Order No. Mic 61-483)

Harold Edgar Clearman, Jr., Ph.D.
Princeton University, 1953

Abstract not available.

Microfilm \$2.75; Xerox \$4.40. 83 pages.

ASTRONOMICAL PHOTOMETRY IN THE 1 TO 3 MICRON REGION

(Order No. Mic 61-2060)

Ernest Günther Reuning, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. Frank Bradshaw Wood

The commercial availability of stable lead sulfide photoconductive detectors has made possible the extension of astronomical photometry into the infrared. The principal objective was the development and construction of an

easily duplicated photometer which, within climatic and intrinsic detector limitations, would have precision and stability comparable to visual-range photometers in a sustained, routine observing program.

A mechanically compact photometer head was built for mounting on the 28 $\frac{1}{2}$ - inch reflector, in which the beam is chopped at 90 cps and is imaged on a chemically-deposited 1.5 x 1.5 mm detector by a fused-quartz Fabry lens.

The cell signal passes through a battery-operated pre-amplifier, mounted on the telescope, to a highly degenerated feedback band-pass amplifier broadly tuned to 90 cps, which greatly reduces the predominant cell current noise. The signal is then rectified in a linear detection circuit and passed to a circuit which integrates the unsmoothed dc signal for one minute and automatically prints the averaged value on a Speedomax recorder. The non-linear addition of signal and noise characteristic of a non-coherent rectifier is compensated by a calibration curve.

The most frequently used filters are a Wratten 87-C, which passes all radiation beyond 9,000 angstroms, and a 25% - half-width interference filter centered on the atmospheric window at 1.6 microns.

Observations have been in progress since the fall of 1959. The stability of the system far exceeds the steadiness of observed conditions, attributed to stable ambient conditions maintained by deliberately not cooling the cell (at the expense of some sensitivity), and by reducing the modulated quanta-exchange of cell with environment through assuring rapid temperature equalization within the photometer and with the telescope mass, and through leaving interior surfaces reflective for low emissivity. Constancy, within the width of the recorder trace, has been maintained for five hours on the cell noise deflection, and for 45 minutes on star signal deflections. At a usable signal-to-noise ratio of 0.5 the limiting magnitude ranges from 4.1 (visual) at Class BO to 8.3 (visual) at Class MO, with the 87-C filter. A significant observation is that the obviously greater relative detector response to late-type stars, and hence the larger infrared color indices for these stars, is not greatly enhanced by restricting the spectral range to the long-wavelength 1.6 - micron window rather than admitting all available radiation beyond 9,000 angstroms. For all but the reddest stars the slopes of the stellar energy curves are similar in this region. Except for spectrophotometric studies feasible only with the very largest telescopes, it is felt that little would be gained by difficult lead-sulfide photometric observations at even longer wavelengths and consequently lower stellar energies.

Objects under observation are semiregular variables, long-period variables, Cepheids, special space-reddened stars, and eclipsing binaries, including beta Lyrae and the Algol system, and others. The depths of primary and secondary minimum of Algol measured with the 87-C filter have been found to be 0.8 and 0.18 magnitude, respectively. Enough observations are available for a solution of the system elements, as seen in the infrared.

The photometer is being adapted to infrared polarization observations by the installation of a Glan-Thompson prism.

Observation under a great variety of climatic conditions and the actual, routine observations have proved this photometer a valuable and reliable astronomical tool in a new and relatively unexplored region of the spectrum.

Microfilm \$2.75; Xerox \$7.60. 162 pages.

THE SPACE DISTRIBUTION OF LATE-TYPE STARS AT THE NORTH GALACTIC POLE

(Order No. 61-3315)

Arthur Reinhold Uppgren, Jr., Ph.D.
Case Institute of Technology, 1961

An objective prism survey of late-type stars has been undertaken in a region of 396 square degrees surrounding the North Galactic Pole with the purpose of determining their space densities at varying distances from the galactic plane. Only those stars have been included for which accurate luminosity types can be detected at the dispersion used in this investigation. A system of classification useable at this dispersion has been established which is able to define accurate luminosity criteria for spectral class G5 and later. A catalogue containing 4027 stars of class G5 and later is presented along with identification charts for all of the stars. This catalogue is probably complete over the entire region to a limiting photographic magnitude of 13.0. Statistical methods have been used to determine the distribution in space for the giant stars extending to distances of over 1000 parsecs from the galactic plane. These space distributions are compared with those obtained by previous investigators.

Microfilm \$2.75; Xerox \$9.00. 198 pages.

HEATING OF STELLAR CHROMOSPHERES BY SHOCK WAVES AND CORONAL EVAPORATION AS A POSSIBLE MECHANISM FOR MASS LOSS IN RED GIANTS

(Order No. Mic 60-5070)

Ray Weymann, Ph.D.
Princeton University, 1959

HEATING OF STELLAR CHROMOSPHERES BY SHOCK WAVES

On the basis of a very simple model for the dissipation of energy by shock waves, the structure of the chromospheres of stars with very different values of the surface gravity is discussed. Sharp jumps in the temperature at certain critical points would be expected. Reasonable chromospheric structures follow from this model for dwarfs, but not for stars of very low surface gravity unless very long period shock waves are considered. The question of the thermal stability of the solutions is discussed.

CORONAL EVAPORATION AS A POSSIBLE MECHANISM FOR MASS LOSS IN RED GIANTS

The consequences of the possible existence of a corona of a red giant are investigated from a hydrodynamical point of view, under the assumption that deposition of mechanical energy is confined to a narrow layer just above

the surface of the star. Because of the energy losses due to radiation, steady subsonic flows do not exist, and only under special circumstances can hydrostatic solutions exist. In contrast, steady supersonic flows can exist and the mass loss accompanying them would be significant

from an evolutionary point of view. However, investigation of the observational consequences of such flows rules them out because of the presence of lines displaced toward much higher velocities than those actually observed.

Microfilm \$2.75; Xerox \$4.20. 78 pages.

BACTERIOLOGY

HETEROTROPHIC CARBON DIOXIDE
FIXATION IN EXTRACTS OF
NOCARDIA CORALLINA

(Order No. 61-3028)

Clarence Leonadas Baugh, Ph.D.
Iowa State University of Science and Technology, 1961

Supervisor: C. H. Werkman

Cell-free extracts of Nocardia corallina contain enzymes which catalyze carboxylation (carbon dioxide fixing) reactions involving phosphoenolpyruvate and the coenzyme A esters of acetate, propionate, and butyrate.

Phosphoenolpyruvate is the carbon dioxide acceptor in two distinct reactions to form oxalacetate. One is an irreversible reaction similar to the one catalyzed by the enzyme phosphoenolpyruvate carboxylase and the other is a reversible nucleotide-requiring reaction similar to the reaction catalyzed by the enzyme oxalacetic carboxylase (phosphoenolpyruvate carboxykinase).

Phosphoenolpyruvate carboxylase is dependent upon manganous ion and requires a reducing agent. Oxalacetic carboxylase requires a bivalent cation (manganese, magnesium, or cobalt) in addition to a nucleotide and is not inhibited by avidin. Inosine or guanosine nucleotides are more active than adenosine or uridine and evidence is presented which indicates that the latter two nucleotides can act indirectly by the way of inosine nucleotides.

Nucleoside diphosphokinase is present in the extracts and is probably responsible for the activity obtained with adenosine or uridine nucleotides.

The cell-free extracts carboxylate the coenzyme A esters of acetate, propionate, and butyrate forming malonyl coenzyme A, methylmalonyl coenzyme A and ethylmalonyl coenzyme A, respectively. Adenosine triphosphate, reduced glutathione, and a bivalent cation (magnesium or manganese) are necessary cofactors.

The carboxylation reactions are inhibited by avidin, an inhibitor of biotin activity, but not by avidin pretreated with biotin. Biotin alone does not influence the reaction nor does it reverse the inhibition caused by avidin.

These results indicate the enzyme (or enzymes) responsible for the carboxylation reactions contains bound biotin.

Methylmalonyl coenzyme A is formed by the extract when either acetate or butyrate is utilized as the substrate. This result was considered indirect evidence for a trans-carboxylation reaction.

Microfilm \$2.75; Xerox \$5.60. 114 pages.

EFFECT OF LOW MOISTURE
ON METABOLISM OF
MICROCOCCUS FREUDENREICHII

(Order No. 61-3151)

Mudambi Veerraghav Rajagopal, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor W. C. Frazier

The effect of solute concentration expressed as water activity (a_w) on the growth and metabolism of Micrococcus freudenreichii in different minimal synthetic media was studied.

A synthetic medium, containing the nine amino acids, alanine, methionine, tryptophan, cystine, phenylalanine, valine, proline and glycine, glucose, salts, B vitamins, adenine, guanine and uracil was developed for growing M. freudenreichii. Alanine, arginine, methionine and tryptophan were found to be essential, whereas glycine, proline, valine, phenylalanine and cystine were increasingly stimulatory in that order. Inclusion of adenine, guanine and uracil stimulated growth markedly.

The optimum a_w for growing the micrococcus in a synthetic or in a glucose yeast extract broth was between 0.993 and 0.96. The lowest a_w at which growth could be initiated in the synthetic medium was 0.865 and in the glucose yeast extract broth 0.860.

Deletion of one or more of the stimulatory amino acids caused a progressive raising of the lower limit of a_w for the growth of M. freudenreichii. For example, with only four amino acids present, the lower a_w limit for growth was raised to 0.95. At an a_w of 0.96, there was a marked lengthening of the lag and generation times, when one or more of the stimulatory amino acids were deleted from the synthetic medium.

M. freudenreichii caused a mixed lactic acid fermentation. Besides lactic acid, appreciable quantities of ethanol, 2,3-butanediol, acetoin and acetic acid were produced from glucose in the synthetic medium. With the lowering of a_w there was an increase in the production of ethanol and acetic and formic acids and a corresponding decrease in the quantity of lactic acid. When one or more of the stimulatory amino acids were deleted from the synthetic medium at an a_w of 0.96, there was a marked increase in ethanol and lactic and formic acids and a fall in lactic acid production. This pattern in the formation of end products might be suggestive of a shift in the metabolic route of the organism at low a_w values. Lactic dehydrogenase might be inactivated at low a_w values. Microfilm \$2.75; Xerox \$5.60. 112 pages.

STUDY OF *Beggiatoa* SPECIES

(Order No. Mic 61-1975)

Raphael Samuel-Maharajah, Ph.D.
The University of Nebraska, 1961

Adviser: Dr. Richard Y. Morita

The sulfur bacteria, *Beggiatoa*, has been reported in the literature since the time Trevisan (1842) first described and gave them their name. However this organism, although mentioned in many textbooks of bacteriology, still remains an academic curiosity. Its physiological, biochemical and morphological characteristics remain obscure. The main deterrent in the study of this microorganism is the difficulty of isolation and cultivation as well as its own intrinsic delicate nature.

Since a large number of cells is a prerequisite for the study of certain metabolic reactions, investigations were undertaken to develop a growth medium for the cultivation of *Beggiatoa*. Using two known strains of *Beggiatoa alba* (ATCC Nos. 11028 and 11029), three different media were developed which supported good growth and delayed lysis up to 24 days incubation. Prolonged growth and the delay of lysis may be due to the incorporation of cysteine in the media. The increased pH of the growth medium and the presence of the K⁺ ions appeared to be causes of the lytic phenomenon of *Beggiatoa*.

Microscopic examination of the cultures of *Beggiatoa* definitely demonstrated the presence of "X" bodies. Three procedures namely: the centrifugation studies, the Pasteur pipette studies and the droplet studies conclusively demonstrated that these "X" bodies have the ability to germinate and form trichomes. Experimental evidence definitely shows that the "X" bodies are a definite stage in the growth of *Beggiatoa*. From careful microscopic examination of the "X" bodies in various stages (during incubation), a life cycle for *Beggiatoa* is proposed.

Manometric studies demonstrated that both sonorated cells and "X" bodies of the two cultures take up carbon dioxide when sulfur compounds served as the substrate. Phosphate and ribose added to the system increased carbon dioxide uptake. Sonorated cells and "X" bodies oxidized sulfide, sulfite, thiosulfate and sulfur to sulfates with a high uptake (ca. 80 uL) of carbon dioxide. Sonorated cells partially oxidized dithionate, trithionate and tetrathionate to sulfates with a low uptake (less than 40 uL) of carbon dioxide. The definite formation of sulfates from the sulfur compounds indicated that a stepwise oxidation process is involved.

Whole cells of *Beggiatoa alba* Nos. 11028 and 11029 were exposed to radioactive carbon dioxide for 10 seconds. The radioactivity fixed in various compounds and identified by paper chromatography were found to be phosphoglyceric acid, fructose-6-phosphate, hexose-diphosphate, glucose-1-phosphate, aspartic acid, serine and alanine.

Microfilm \$2.75; Xerox \$3.80. 70 pages.

IMMUNOLOGICAL DETECTION OF INSECT INFESTATION IN WHEAT AND PHYSICAL CHARACTERIZATION OF THE EXTRACTED INSECT PROTEINS

(Order No. 61-3018)

Joseph Bernard Schleicher, Ph.D.
Kansas State University, 1961

The problem of detecting insect infestation in stored wheat was investigated using the immunological precipitin ring test. Preliminary experiments showed that extracts of rice weevil adults prepared with phosphate buffer at pH 8.0 produced better antigens than did the 0.85 per cent sodium chloride extracts of these insects. Extracts made from a mixture of flour and insects did not seem to alter the results of the precipitin ring tests.

The insect protein from rice weevil adults, extracted in phosphate buffer, was clarified by ultracentrifugation. The resulting supernatant retained most of the serological precipitative ability of the original extract. Proteins in the ultracentrifuged extract were precipitated with 50 per cent saturated ammonium sulfate. The precipitated protein was dialyzed against buffer and finally dried by lyophilization. The dry extract gave positive reactions in the color tests for proteins such as the biuret, Millons, xanthoproteic and ninhydrin tests. The Hopkins-Cole reaction was negative. The dried extract was readily soluble in distilled water, 0.85 per cent sodium chloride, dilute sodium hydroxide, phosphate buffer at pH range 6 to 9 and ammonium hydroxide. It was only slightly soluble in dilute hydrochloric acid, and in phosphate buffer below pH 6.0. It was insoluble in petroleum ether, concentrated phosphoric acid, 75 per cent ethyl alcohol, butanol, benzene, acetone, chloroform, and trichloroacetic acid.

Studies by horizontal paper and starch gel electrophoresis techniques did not yield any resolution of the dry extract. However, on the continuous flow electrophoresis apparatus, with phosphate buffer at pH 8.2, the extract moved in a single band. Moving boundary electrophoresis studies indicated that a single protein substance was present. The molecular weight of the protein in the extract was determined by the analytical ultracentrifuge to be between 17,150 and 13,800.

Infra-red studies showed an absorption curve characteristic of a large protein-like molecule. Ultraviolet absorbance studies indicated the presence of unsaturated aliphatic carbon bonds in the extract.

Two dimensional paper chromatography of hydrolyzed samples of the dried extract showed that the following amino acids were present: alanine, arginine, aspartic acid, glycine, glutamic acid, leucine or isoleucine, lysine, phenylalanine, proline, serine, tyrosine, threonine, and valine. Hydrolysis of crude extracts of rice weevil adults yielded beta-alanine, ornithine, alpha- or beta-amino butyric acids, and tryptophan in addition to those mentioned above. Hydrolysis of larval rice weevils yielded histamine in addition to all the above.

In the immunological studies, when adjuvants were mixed with the phosphate-buffered antigen, no increase in specific antibody titer in rabbits was detected. A standard curve to estimate the smallest quantity of detectable insect infestation in flour was determined by the precipitin ring test. Extracts containing 0.05 gm of rice weevil adults per ml were detectable with a titer of 1/10.

Extracts of rice weevil larvae gave titers of 1/320 with a rice weevil adult antiserum. Phosphate-buffered extracts of confused flour beetles and red flour beetles showed slight cross precipitation with adsorbed rice weevil adult antiserum.

Microfilm \$2.75; Xerox \$4.20. 77 pages.

ST. LOUIS ENCEPHALITIS VIRUS IN PRIMARY TISSUE CULTURE.

(Order No. 61-3000)

Evelyn Bartels Wallraff, Ph.D.
University of Arizona, 1961

Supervisors: H. H. Smith, M.D.
Kenneth F. Wertman

The cytopathogenic effect (CPE) of the Winkler strain of St. Louis encephalitis virus (SLE) was studied in hamster kidney and chick embryo cell cultures.

Hamster kidney cell cultures provide a suitable biological system amenable to controlled variation for study of the CPE of SLE virus. The Winkler strain of SLE produced a definite CPE under the conditions described at about the sixth day after inoculation and no significant differences were noted when maintenance solution was substituted for

bovine albumin buffered saline (BABS) in the preparation of virus dilutions. Calf serum outgrowth medium produced better hamster kidney monolayer cultures than did rabbit serum outgrowth medium under comparable conditions.

From studies of the CPE produced by graded doses of SLE virus in hamster kidney cell cultures from normal and immunized animals grown in normal and SLE immune rabbit serum outgrowth media, the following conclusions have been reached. 1. Kidney cells from hamsters injected intraperitoneally with SLE virus four and six weeks before being sacrificed, produced significantly fewer cell monolayers when grown in normal rabbit serum outgrowth medium than did kidney cells from normal hamsters. 2. Neither SLE-immune rabbit serum outgrowth medium nor kidney cells from monolayers of SLE-immunized hamsters produced any significant alteration in CPE obtained with the Winkler strain of SLE virus.

Studies of the Winkler strain of SLE in primary chick embryo cell cultures have indicated that stage of development of embryos processed for tissue culture, media composition and the number of cells dispersed are all important factors in the production of cell monolayers satisfactory for assay of SLE virus by either the tube CPE or plaque method.

Testing of media, reagents and techniques using guinea pigs and hamsters indicated that spleen cell cultures comparable to kidney cell cultures were unobtainable by either the trypsinization procedure or collagenase treatment.

Microfilm \$2.75; Xerox \$4.80. 94 pages.

BIOGRAPHY

THE CORRESPONDENCE OF JAMES BOSWELL AND JAMES BRUCE

(Order No. Mic 60-4661)

Nellie Pottle Hankins, Ph.D.
University of Kansas, 1960

James Boswell the literary man, author of the *Life of Johnson*, has been familiar to readers for more than a century and a half; Jamie Boswell the young rake has been revealed during the last thirty years as the editing of his long-lost personal journal has progressed. Less well known is James Boswell, Laird of Auchinleck, the family estate in Ayrshire originally granted by James IV to Thomas Boswell in 1504. Yet Boswell took his greatest pride in his role as "an ancient Baron."

The letters of Boswell to his second overseer at Auchinleck were included without annotation in Chauncey Brewster Tinker's edition of the letters. With the discovery of the Boswell Papers at Malahide Castle, a more personal correspondence came to light between Boswell and his first overseer, James Bruce. Except for a few of these letters which were published in *The Private Papers of James Boswell from Malahide Castle*, the bulk of the correspondence appears for the first time in this dissertation. There are sixty-six letters from Bruce to Boswell, thirty-four drafts of replies from Boswell to Bruce, and mention, sometimes

with extracts or short accounts of the contents, of ninety-nine more Boswell-Bruce letters in Boswell's unpublished Register of Letters.

The letters have been edited against a background of eighteenth century agricultural treatises, social studies of Ayrshire, Boswell's journals and other letters, and unpublished manuscripts such as his Register of Letters, family wills, and the Entail of the Auchinleck estate.

James Bruce (1719-1790), who was born at Auchinleck Place, knew Boswell intimately from his birth until five years before his death. The character of his laird which Bruce displays in these letters was therefore established over a much longer space of years than the impressions of other contemporaries who have left their record of Boswell. The letters are valuable, not only for their new picture of Boswell himself, but also for the information which they add about his father, Lord Auchinleck, his wife and five children, and his deranged brother John. They indicate where he was at a time when his whereabouts was otherwise uncertain because he was keeping no journal at the time. They provide answers to a few questions which have arisen about Boswell and his friends. Frequent mention in the letters of Boswell's law practice and his literary efforts indicate that Bruce's interest in his laird was far beyond that expected of him as overseer.

An attempt has been made in the dissertation to identify the various tenants and to locate them on the thirty-odd

farms which make up the estate. Many of them emerge as real people. The type of eighteenth-century agriculture which involved the burning of sea shells for lime, fallowing of fields, fence building by "plashing," and strewing of muddy byres with rushes is revealed in the letters. Although some influence of the abstract Physiocratic theories of agriculture may have worked back to Boswell through Adam Smith, a member of the Literary Club, and Boswell's friends who were taking a more undivided interest in farming, the spirit of these letters is feudal and traditional. Both Boswell and Bruce, however, were interested in such progressive measures as rotation of crops and the intro-

duction of new crops, and both were especially interested in the forestation of Auchinleck. It is interesting to note that the enclosure of common lands was going on at Auchinleck, sometimes at the request of the tenants themselves, with few of the evil consequences which Goldsmith deploras. The good feeling which existed between the laird and his people may be accounted for partly by Boswell's basic kindness to his tenants, and partly by the shrewd balance of compassion and firmness shown by Bruce-- "honest James," as Boswell called him-- who gave a lifetime of service to the Boswells of Auchinleck.

Microfilm \$4.75; Xerox \$16.65. 369 pages.

BIOLOGY - GENETICS

THE EFFECTS OF RECOMBINATION ON VIABILITY IN SECOND AND THIRD CHROMOSOMES OF *DROSOPHILA MELANOGASTER*

(Order No. 61-3253)

Archie Cornelious Allen, Ph.D.
University of Pittsburgh, 1961

In "well adapted" populations there exists a wide array of viability determinants that are not discernible to the casual observer. With special mating techniques these viability determinants, which reside in genes or genic complexes, can be sorted from the population. It was the purpose of this experiment to extract "normal viability" second and third chromosomes from a laboratory population of *D. melanogaster* and to test the effects of recombination and segregation on viability.

Ten strains with "normal viability" homozygous second and third chromosomes were chosen from 100 males that had been tested for viability values. Each strain was crossed with all other strains and the effects of crossing over in F_1 females, as well as the effects of segregation by the use of F_1 males, were observed (by testing 450 recombinant and non-recombinant, second and third chromosomes for a total of 1,800 chromosomes) for variation in viability with special marker techniques.

The average viability was increased by recombination in homozygous second chromosomes, but decreased in homozygous third chromosomes and double homozygotes. Segregation of whole chromosomes acted to decrease viability in both chromosomes and double homozygotes, presumably by producing newly assorted non-selected combinations of chromosomes.

Recombination produced more variation in viability values than did segregating whole chromosomes. However, segregation produced significantly more variation than the original "normal viability" strains. Statistical analyses of the data show that variation produced by recombination can be attributed to polygenic interaction of linked loci, whereas variation arising from segregation of whole chromosomes can be attributed to chromosomal interaction.

There seems to be a real genetic difference between second and third chromosomes in their response to recombination and segregation of unrecombined chromosomes.

Recombination engenders significant variation for both, but increases viability in II and lowers it in III. Chromosome III showed more chromosomal interaction than II for segregating whole chromosomes.

The number of lethals produced in this experiment does not support evidence for recombinational (synthetic) lethals in this population.

It was concluded that recombination and segregating whole chromosomes produce variation in viability that reverts "normal" homozygous chromosomes toward the level observed in the original highly variable population.

Microfilm \$2.75; Xerox \$3.80. 70 pages.

INDEX SELECTION AS INFLUENCED BY ERRORS OF PARAMETER ESTIMATION

(Order No. 61-3036)

Dewey Lynn Harris, Ph.D.
Iowa State University of Science and Technology, 1961

Supervisor: L. N. Hazel

The influence of errors of parameter estimation upon index selection has been studied using two techniques. The first of these was to develop approximate equations for certain functions of interest, while the second was the Monte Carlo simulation of the sampling distribution of the parameter estimates and a study of the resulting progress and estimates of progress. Unfortunately, the two methods of study did not give equivalent results, and due to the realized possibility of inaccuracies in the approximate equations, the Monte Carlo results were taken to be more realistic in spite of quite large sampling errors in these results.

Of primary interest in this study were (1) the closeness of the distribution of realized progress from selection for particular calculated indexes to the maximum possible gain from selection, and (2) the accuracy of the usual estimates of progress as estimators of the true expected gains for a particular calculated index. In all situations the gains were considered to be those which would result

when selection would be carried out in an infinite population, and the further variation due to the finiteness of the population in which selection might be carried out was excluded from consideration in this study.

Even with the large sampling errors encountered in the Monte Carlo results certain trends are apparent from this study. When the heritability values for both of the two traits considered in the index are increased, the fractional decrease in progress becomes smaller. Similar trends for the fractional decrease in progress are noted when the genetic correlation between the two traits is increased, when the number of paternal-half-sib groups used for estimation is increased, and when the number of offspring per sire group is increased.

The mean difference between the estimates of progress from selection and the expected genetic progress from selection for particular calculated indexes tends to be negative for combinations of the true parameters where either the heritabilities or the genetic correlations are large and for most combinations of number of sires and number of offspring per sire. This indicates that in these cases there is a tendency for under-estimation of the progress from index selection. A tendency is noted for the mean squared difference between the estimated progress and the expected progress for calculated indexes to increase as the heritabilities for the two traits increase and as the genetic correlation between the two traits increases. For a particular combination of the true parameters this latter function, which is a measure of the accuracy of predicting genetic progress from index selection, tends to decrease slightly as either the number of sires or the number of offspring per sire increases.

Generalizations upon these observed trends do not seem feasible or desirable at the present time because the combinations of true parameters which were studied here do not include situations where the environmental correlation between the two traits is non-zero, where the heritability values for the two traits are unequal, or where the two traits have unequal economic importance. However, it is hoped that the present work with the desired future extensions will lead to a deeper understanding of index selection and its relationship to estimation procedures.

Microfilm \$2.75; Xerox \$6.40. 133 pages.

CYTOGENETIC EVALUATION AND
INHERITANCE OF RESISTANCE TO LEAF
RUST IN HYBRIDS INVOLVING CERTAIN
COMMON WHEAT STRAINS DERIVED
FROM TRITICUM TIMOPHEEVI ZHUK

(Order No. 61-3013)

Shivcharan Singh Maan, Ph.D.
Kansas State University, 1961

Sixteen advanced generation common wheat strains derived from Triticum timopheevi were studied. Inheritance of leaf rust reaction was followed in crosses of eight of these (1, 7, 8, 11, 12, 14, 15, 20) with Cheyenne. Manner of inheritance of rust reaction indicated that irrespective of the persistent meiotic instability of some of the strains (8, 12, 20), the chromosome(s) carrying the gene(s) for rust resistance were pairing and disjoining regularly in the hybrid progenies of the crosses studied.

Seven of the eight strains which had a stable resistance to certain specific groups of leaf rust races, were susceptible to certain others. Another six strains (3, 5, 6, 10, 13, 21) were susceptible to all 11 races of leaf rust used. However, the susceptible reaction of these 13 strains to several of the races was not stable. Seedlings grown at a temperature of 60° F to 65° F prior to inoculation gave a high type of resistance to the same races to which these strains were susceptible when grown at the optimum temperature of about 70° F to 75° F. Under similar conditions plants of the heterozygous portion of the hybrid progenies of some of these strains gave reactions opposite of the usual Y type with increasing resistance from leaf base to leaf tip.

Strain 7, one of the cytologically stable strains, had a combined stable high type of resistance to all 11 races of leaf rust (1, 5, 6, 9, 9A, 11, 15, 58, 77, 105, 105A, 122, 131: these belonging to 8 different race groups; 1, 2, 3, 5, 6, 9, 10, 13), with which it was tested. In a cross with Cheyenne, a single major gene or closely linked genes in Strain 7 controlled inheritance of resistance to nine of the above races, representing all eight physiologic race groups used. Segregation for reaction to certain groups of races was modified by additional or modifying genes.

Linkage was less extensive in another three crosses involving cytologically stable strains 1, 11, 15 and Cheyenne. Reaction to respective groups of races, with which crosses involving these strains were tested, was associated in inheritance and in each cross appeared to be determined by a single major gene.

In the cross, Strain 14 x Cheyenne, inheritance of reaction to leaf rust race 9 was conditioned by three independently inherited genes, one of which was contributed by the susceptible parent, Cheyenne.

In order to find cytological evidence for the nature of genetic transfer from T. timopheevi to the genome of common wheat, a comparative study was made of the chromosome behavior during meiosis in stable Strain 11, and also in F₁ and F₂ progenies of the cross: Strain 11 x Cheyenne. The F₂ progeny, irrespective of the rust reaction of the individual F₂ plants, had most irregular meiosis and had least close and least regular pairing at MI. Pairing was closer in F₁. On an average, Strain 11 had one open bivalent per PMC at MI, the F₁ had two and F₂ had four. Inheritance of rust reaction as well as the less regular meiosis in F₂ plants, irrespective of their rust reaction, indicated that in this cross chromosomes carrying the gene for rust resistance were not involved in cytological irregularities.

Pattern of chromosome behavior in three of the meiotically unstable strains 8, 12 and 20 was studied in detail. Statistically it was shown that meiotic instability was influenced by external environment during developmental stages of spikes and spike parts and many irregularities were already present before meiosis. PMC with deviant chromosome numbers occurred along with the normal PMC, 44 different chromosome numbers ranging from 5 to 76 being recorded among 212 deviant PMC. MI pairing indicated that these chromosomes were randomly assorted.

Further, genetic studies involving inheritance of reaction to leaf rust race 9 showed that about 3 percent of the female gametes of the unstable strains 8, 12 and 20 lacked the gene for rust resistance. Also the extent to which the chromosome carrying the gene for rust resistance was affected by somatic instability was indicated by 2.8 percent of the F₁ spikes giving aberrant but a consistently uniform pattern of segregation. Microfilm \$2.75; Xerox \$5.60. 115 pages.

ISOLATION AND CHARACTERIZATION
OF THE DEOXYRIBONUCLEIC ACIDS OF
DROSOPHILA MELANOGASTER

(Order No. Mic 61-1186)

Charles Grandison Mead, Ph.D.
Michigan State University, 1960

Major Professor: Allen S. Fox

A procedure is described for the isolation of DNA from *Drosophila melanogaster*. An enzymatic deproteinization procedure is described which results in a product that is free from RNA and protein and not extensively denatured. Two types of DNA are observed upon precipitation of the isolated product with cold ethanol. One of these is fibrous in nature, typical of most DNA's, whereas the other is of a flocculent nature. The isolated DNA is found to be relatively nonviscous even in concentrated solutions. Since the DNA is not denatured to any large extent, this observation is interpreted to mean that *Drosophila* DNA has a relatively low molecular weight.

Perchloric acid and formic acid hydrolysates of the DNA contain the purines adenine and guanine, and the pyrimidines thymine, cytosine, and 5-methylcytosine. The 5-methylcytosine is characterized both chromatographically and spectrophotometrically. The exceptional pyrimidine, 5-methylcytosine, is not observed when the DNA is subjected to mild alkaline conditions prior to acid hydrolysis. It is suggested that the amino group at the 6 position of the pyrimidine ring of the 5-methylcytosine nucleoside or nucleotide is alkali labile, and that deamination under mild alkaline conditions results in the corresponding thymine derivative.

Nucleoside preparations of *Drosophila* DNA hydrolysed with snake venom and subjected to paper chromatography exhibit two unexpected free pyrimidines. These are identified as uracil and thymine. It is suggested that these two pyrimidines result from the degradation of deoxy-5-methylcytidine under acid conditions.

Nucleotide preparations of *Drosophila* DNA hydrolysed with purified snake venom phosphodiesterase and subjected to paper chromatography exhibit the unexpected pyrimidine uracil. This pyrimidine also probably results from the degradation of deoxy-5-methylcytidylic acid under acid conditions.

Ion exchange chromatography of snake venom phosphodiesterase digests of *Drosophila* DNA result in the recovery of five UV. absorbing peaks. The second, third, fourth and fifth peaks eluted are identified as deoxycytidylic, deoxythymidylic, deoxyadenylic and deoxyguanylic acids respectively. The first peak eluted is probably deoxy-5-methylcytidylic acid but could not be identified as such by rechromatography on paper due to the small quantities of this compound recovered.

A quantitative difference in the molar content of 5-methylcytosine is demonstrated between the two types of ethanol-precipitated DNA's. The flocculent type is demonstrated to contain more 5-methylcytosine than the fibrous type.

Microfilm \$2.75; Xerox \$3.00. 52 pages.

STUDIES ON VIRAL INTERFERENCE:
INFLUENZA VIRUS CULTURED IN VITRO
ON CHICK EMBRYO CHORIO-ALLANTOIC
MEMBRANE FRAGMENTS.

(Order No. Mic 61-2898)

Kathryn Marilyn Smart, Ph.D.
Cornell University Medical College, 1961

Under conditions providing equivalent viral yield from suspended shake cultures of chick embryo chorio-allantoic membrane fragments, it has been shown that the minimal dose of virus required for the induction of interference varies in inverse fashion with membrane age. Cortisone was effective in negating interference induced in the older membrane (10 days or more). The lesser degree of interference in the younger membrane was not negatable by cortisone. Four varied types of interference agents derived from the PR 8 strain of influenza A exhibited similar interference patterns in this system to a Lee challenge.

Alternative interpretations are offered. It is possible that these agents exhibit identical interference patterns because they are all mediated through one agency -- interferon. Evidence is presented suggesting that the phenomena may also be interpreted as a reflection of the decrease in viral synthetic potential with increase in membrane age. The properties of interferon in this test system, the possible contribution of viral induced inflammation in its in ovo production, and a proposed basis for the cortisone induced improvement in viral synthetic potential are discussed. An acid stable blocking antigen in influenza seeds, related to hemagglutinin content, is described.

Microfilm \$2.75; Xerox \$6.80. 144 pages.

GENETIC-ECONOMIC FACTORS IN BROILER
MEAT PRODUCTION

(Order No. 61-3050)

John Henry Strain, Ph.L.
Iowa State University of Science and Technology, 1961

Supervisor: Arne W. Nordskog

The influence of several factors on income over feed costs in a broiler enterprise was studied using five years data from the Maine Random Sample Broiler and Production Test. Production factors associated with parent flock performance included egg production (X_1), percent hatching eggs (X_2), hatchability (X_3) and feed conversion per dozen eggs (X_4). Factors associated with broiler performance included livability (X_5), 8 week broiler weight (X_6), 8 week feed conversion (X_7) and percentage of broilers Grade A or better (X_8).

Regression equations for individual years were calculated and showed good agreement between tests. The pooled regression was: $Y = .043X_1 + .051X_2 + .077X_3 + .433X_4 + .439X_5 + 9.526X_6 - 16.240X_7 + .283X_8 - 43.113$.

This regression equation accounted for 85.9 percent of the total variation in Y. The factors having the largest effect on net income were X_6 and X_7 .

The results obtained in the regression analysis indicate that breeders should place most emphasis on broiler traits

but little emphasis on parent flock traits. However, since this analysis is based only on phenotypic values and ignores genetic correlations between performance traits, the real importance of parent flock performance could not be critically evaluated.

The principal objective of the second part of the study was to derive profit equations in terms of production traits for both an integrated and a non-integrated broiler enterprise. In the former, the hatchery supply flock is the integral part. The production traits in the supply flock were egg production, adult body weight and hatchability, and in the broiler progeny, feed conversion, body weight and livability. The two equations derived may be used to compute profit potential under specified conditions associated with a broiler enterprise.

The influence of changes in egg production, adult body weight and prices on profit potential was computed using the two derived equations. In addition, the level of genetic correlations between the traits was considered. When genetic correlations are not equal to zero, the indirect effects of selection for a particular trait may be evaluated. The correlated response may be favorable or unfavorable depending on the magnitude and sign of the genetic correlations.

In a non-integrated enterprise, if all genetic correlations are assumed to be zero, maximum profit potential is associated with maximum egg production. On the other hand, if the genetic correlation between egg production and

8 week body weight is -0.5 , then 45 percent egg production is optimal. Changes in broiler and feed prices merely raise or lower the level of the profit potential. The importance of adult body weight in a non-integrated enterprise mainly depends on how strongly correlated body weight is with egg production and 8 week weight. If the genetic correlations are zero, profit potential varies inversely with body weight, but if the correlations between adult body weight and broiler weight are as great as 0.5 , profit potential increases directly with body weight.

In an integrated enterprise the profit unit is the breeder hen. Profit potential is a maximum when egg production is a maximum. However, indirect responses due to genetic correlations with egg production have little influence on profit potential. Optimum adult body weight depends critically on the particular genetic correlations assumed. If the correlations are zero, changes in adult body weight have little effect on profit potential. If the correlation between adult body weight and broiler body weight is 0.5 , maximum adult body weight is optimum. If the correlation between adult body weight and egg production is -0.5 , minimum body weight is optimum. Thus it seems important that more accurate estimates of genetic correlations involving production traits of parent flocks and broiler progeny are desirable. Commercial broiler breeders would then be in a position to optimize attention directed towards adult body weight and rate of egg production.

Microfilm \$2.75; Xerox \$5.00. 100 pages.

BOTANY

ECOLOGICAL LIFE HISTORY OF THE GENUS ANTENNARIA IN SOUTHERN WISCONSIN

(Order No. 61-3085)

Edward Wesley Beals, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Grant Cottam

The genus *Antennaria* is a highly variable group of plants, in which divisions between species have been obscured by hybridization, polyploidy, and apomixis. The most common forms in southern Wisconsin are the diploid narrow-leaved species (*A. neglecta*) and the polyploid broad-leaved species (*A. parlinii*). This study covered four years of observation and experimentation on the life history and ecology of *Antennaria*.

Seedlings are often established in mats of moss, where the moisture supply is relatively high. Once established, the plants send out stolons each year, eventually producing large clones under favorable conditions. *Antennaria* is dioecious. The polyploid *A. parlinii* can produce seed both parthenogenetically and sexually. Diploid species require fertilization to produce seed. Pollination may be effected by insects, especially by short-tongued bees. Stratification accelerates seed germination and in some species may be necessary for germination.

Extracts of *Antennaria* plants inhibit the growth of many

other species of plants. There is a slight autotoxic reaction of *Antennaria* to the extract. Decay reduces the antibiotic activity of plant material, and mineral nutrients apparently deactivate the substance also. Leaf hairs, flower heads, and fresh leaves produce the most potent extract. Extracts from plants collected in May or June were more active than those collected in other months. Clones of *Antennaria* varied widely in the effectiveness of their extracts. Shade and wet conditions inhibit the production of the toxin somewhat. In the living plant, the substance is apparently secreted from the leaves.

Antennaria is found in many plant communities, but is most prominent in oak barrens, cedar glades, and dry-mesic prairies. *Antennaria* increases under grazing pressure. In open habitats many species of plants are negatively associated with *Antennaria* clones. Further, the height of these plants and often their flower production are reduced inside the clones.

Factors which enable *Antennaria* to compete successfully in various plant communities include genetic diversity, polyploidy, drought resistance, wintergreen leaves, and the secretion of an antibiotic into the soil.

Microfilm \$2.75; Xerox \$7.80. 168 pages.

ALGAE OF THE SONORAN DESERT IN ARIZONA

(Order No. Mic 61-2992)

Roy Eugene Cameron, Ph.D.
University of Arizona, 1961

Supervisor: Francis Drouet

A study was made of the algae of southern Arizona, of which 1,150 specimens are preserved in herbaria. Most of the species were soil algae. The following list summarizes the taxa of southern Arizona algae:

	Families	Genera	Species
BLUE-GREEN ALGAE	7	27	84
GREEN ALGAE	16	36	52
YELLOW-GREEN ALGAE	5	3	2
CHRY SOMONADS	1	1	1
EUGLENOIDS	1	3	4
DINOFLAGELLATES	1	1	1
RED ALGAE	2	2	2

The commonest species include *Microcoleus vaginatus* (Vauch.) Gom., *M. chthonoplastes* (Mert.) Zanard., *Scytonema hofmannii* Ag., *Schizothrix macbridei* Dr., *Nostoc muscorum* Ag., and *Plectonema nostocorum* Born. Microfilm \$2.75; Xerox \$6.20. 126 pages.

PURIFICATION, ASSAY AND STRAIN DIFFERENTIATION OF BROMEGRASS MOSAIC VIRUS.

(Order No. 61-3007)

Ren-jong Chiu, Ph.D.
Kansas State University, 1961

A technique for quantitative assay of bromegrass mosaic virus has been developed using *Datura stramonium* L. as an assay host. All isolates of BMV except the type culture induced ring lesions on inoculated leaves in about seven days at 22°C. The plant was most susceptible at the 4-6 leaf stage. Newly developed leaves and old ones approaching senescence were highly resistant. In uniformity trials in which half-leaves of plants were inoculated in the same manner, comparisons of the magnitude of variance were made between designs involving 4 half-leaves and 6 half-leaves; the 4 half-leaf was as efficient or more efficient than the 6 half-leaf design. This was true probably because of the greater variation in susceptibility among the leaves associated with the 6 half-leaf design.

Dilution curves of the virus in wheat, barley, and *Poa pratensis* L. were obtained. A linear relationship between the number of lesions and the dilution of inocula was indicated in a portion of the curves which corresponded to the dilution range $10^{-2.0}$ to $10^{-4.0}$. Differences between two inocula differing in virus content by 25 percent were con-

sistently detected statistically by using 4 half-leaves in 32 plants. A 20 percent difference could not be detected, however.

Some factors that affect the formation of BMV lesions in *D. stramonium* were studied. K_2HPO_4 at concentrations 0.01-0.1 M, pH 7.0 and 8.2, had deleterious effects on lesion production. The buffer showed no beneficial effect at pH 5.6, a value near to the optimum (pH 6.0) for the establishment of infection. The pH stability range of the virus was between 4-5.6. Darkening of plants for 24 hours before inoculation increased plant susceptibility while a similar treatment after inoculation produced the reverse effect.

A high pre-inoculation temperature for 4-8 hours resulted in an increase or decrease in susceptibility depending on the humidity in the plant environment. The greatest lesion numbers were obtained from 34°C and 28°C when the humidity was 70-90 percent and 35-55 percent, respectively. Fewer lesions were produced from 34 to 28°C than from 22 and 16°C, if the humidity was lower. A post-inoculation temperature of 18 and 22°C was found suitable for optimum lesion formation.

Two purine analogues, 8-azaxanthine and 8-azahypoxanthine, had a beneficial effect specifically on BMV lesion formation in *D. stramonium*. Applied as leaf sprays after inoculation, the compounds characteristically hastened lesion expression, reduced lesion size, and increased lesion numbers. However, these effects were found to be accompanied by a reduced rate of virus multiplication in the case of 8-azaxanthine.

A purification procedure consisting essentially of n-butanol treatment and cyclic low and high speed centrifugations has been developed for BMV. n-Butanol was added to plant juice to give a 6 percent content and was allowed to act less than 24 hours. This clarified the juice effectively without decreasing the virus infectivity. The clarified plant juice, after standing or being dialyzed over night, was subjected to the initial cycle of low (2200 G, 30 min.) and high (78,400 G, 2½ hr.) speed centrifugations. The re-suspended pellet was again centrifuged at low and high (105,400 G, 30 min.) speeds for 1 or 2 cycles. Through this procedure, plant juices from infected plants always gave a final glassy pellet while comparable samples from healthy plants did not. The suspensions of the purified virus were infectious at 3 µg/ml or lower dilutions. Phosphate buffer at 0.01-0.025 M, pH 5.6, was used most frequently as the diluent of the virus pellet.

The particles of BMV measured 32 mµ in diameter under the electronmicroscope and were spherical in gross appearance. Particles shadowed with uranium at 26° gave angular shadows which suggested a dodecahedral shape for the virus. This is not in agreement with Kaesberg who suggested an icosahedral shape.

Based on plant reactions, two distinctive strains of BMV were recognized among the 18 isolates tested. The "ordinary strain" comprising 17 of the 18 isolates induced no lesions on cowpea plants, but necrotic ring lesions on *D. stramonium* with an incubation period of seven days. By contrast, the "type strain" consisting only of the type culture induced ring lesions in cowpea plants. It induced no lesions or few erratic lesions in *D. stramonium* with an incubation period one week longer than with the ordinary strain. Cross-precipitation of the two strains as antigen with the antiserum prepared against the other strain was obtained. Microfilm \$2.75; Xerox \$6.00. 121 pages.

SEED DORMANCY IN ABUTILON THEOPHRASTI
AND POLYGONUM PENNSYLVANICUM

(Order No. Mic 61-3041)

Lucien Joseph LaCroix, Ph.D.
Iowa State University of Science and Technology, 1961

Supervisor: David W. Staniforth

Seed dormancy in Abutilon theophrasti Medic. and Polygonum pensylvanicum L. was studied using techniques of embryo culture, electron microscopy and biochemistry in addition to the usual methods of seed germination and after-ripening.

Seed dormancy in A. theophrasti is due primarily to an impermeable seed coat; germination inhibitors play a secondary role in dormancy by controlling subsequent growth after imbibition, the initial germination phase, has occurred. Data have been obtained in support of a proposed sequence of events which may result in the interruption of dormancy and emergence of seedlings of this species under natural conditions. The sequence consists of several steps, the first of which involves disruption of the seed coat barrier to water imbibition. This seed coat rupture invariably occurs in a region adjacent to the chalazal slit, a discontinuity in the thick walled palisade layer which surrounds the seed. Following rupture of the seed coat, imbibition occurs, and growth processes leading to elongation of the radicle are initiated. Inhibitors may play a role in the germination process at this stage and radicle elongation may cease just prior to or immediately after penetration of the seed coat. This dual control mechanism may be important in maintaining seed in a non-germinable condition for a period of a number of years.

Preliminary studies of seed dormancy in P. pensylvanicum have revealed a complex system governing germination in this species. Freshly harvested seed is highly dormant, while isolated embryos from this seed grow normally when cultured on an artificial medium. Dry stored seed remains in a dormant condition, however, the germination control mechanism appears to shift to an embryo dormancy. Cultured embryos from seed stored under these conditions for two or more years fail to grow or occasionally produce dwarfed seedlings. The usual after-ripening treatment, incubation for extended periods on a moist stratum at low temperatures, was utilized to break this type of dormancy with some degree of success.

Studies of cellular fine structure in root tips of dormant and non-dormant embryos revealed one pronounced difference with the examination of a limited number of specimens. Electron dense particles were found in nucleoli of cells of non-dormant embryos and not in cells of dormant embryos. These particles were concentrated in the nucleoli, but some were found in the nucleus exterior to the nucleolus, and in the cytoplasm. This observed difference in cellular fine structure may indicate basic changes in metabolic pattern which are coincident with the transition from dormant to non-dormant state.

Microfilm \$2.75; Xerox \$4.60. 90 pages.

A NATURALLY OCCURRING CHELATE OF
IRON IN XYLEM EXUDATE

(Order No. Mic 61-3162)

Walter Egid Schmid, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor G. C. Gerloff

Under the pH conditions normally found in plant xylem, ferric iron would be expected to form extremely insoluble phosphate and hydroxide precipitates, and very little iron would remain in solution. If such precipitates were present in the xylem stream, the quantities of iron transported from the roots to the leaves and shoots would be small and iron deficiency would result.

Since plants growing under normal conditions do not exhibit iron deficiency, there is the possibility that the element is present in the xylem in a complex which prevents precipitation of iron and serves as a transport form of the element. Several organic compounds, which may act as metal chelaters, are known to be present in xylem fluid.

These experiments were initiated to determine whether or not an iron-containing complex, capable of preventing iron precipitation, does occur in xylem exudate. After this was established, attempts were made to isolate and purify the natural complexing agent as initial steps in its positive identification.

Most of the studies reported were carried out with tobacco plant exudate. It was found to contain about 1 ug of iron, 100 ug of phosphorus, and 70 ug of nitrogen per milliliter. The pH was 5.5.

Millipore filtration did not remove iron from exudate. In contrast, Millipore filtration of a synthetic iron-phosphate solution, prepared to approximate the iron and phosphorus contents of exudate as well as the pH, almost completely removed the iron. These results seemed to discount the presence of an iron-containing precipitate in exudate.

Filtration through a column of Sephadex, a gel filter used to separate molecules on the basis of size, showed that neither nitrogen nor phosphorus was associated with exudate iron. This work also demonstrated that exudate iron was associated with a large molecule since the iron moved directly through the gel filter.

Paper chromatography for amino acids, sugars, and organic acids gave no indication of an association between any of these materials and exudate iron. In no case was exudate iron moved out of the origin by solvents used to chromatograph these materials. Exudate iron was successfully moved away from the origin in solvents used for chromatography of tannins, iron-containing porphyrins, and phenols. In the latter case exudate iron was moved from the origin to an R_f of about 0.75, the location of a spot which absorbed in the ultraviolet.

When iron complexes with Tiron and with chromotropic acid were chromatographed in the same solvent iron also was moved away from the origin. In the case of iron-Tiron, the complex moved to R_f 0.75; in the case of iron-chromotropic acid it moved to R_f 0.9.

Iron could not be removed from exudate by cation exchange resins, but it was taken up by an anion exchange resin. It could be eluted from the anion exchange resin with 0.25 N HCl solution and subsequently could be reattached to the same resin. This indicated that the entire complex was eluted intact from the resin. The anionic nature of the complex was demonstrated by these experiments.

Extraction with organic, water-immiscible solvents

failed to remove iron from exudate. Neither could the complex be re-dissolved intact from residue of exudate which had been evaporated to dryness.

By means of time-color development studies with a variety of reagents which form colored complexes with iron, the apparent (log K) of exudate for iron was shown to be between 17.0 and 20.7.

While the identity of the naturally occurring complexer

has not been established positively, on the basis of the results with paper chromatography as well as with comparative behavior of complexes of iron with phenolic substances it is suggested that the iron-complexing agent in tobacco exudate may be a phenol. Procedures have been developed which will be useful in purifying the iron complex prior to its characterization.

Microfilm \$2.75; Xerox \$3.80. 70 pages.

CHEMISTRY

CHEMISTRY, GENERAL

ELECTROLYTIC SOLUTION THEORY:
FOUNDATIONS OF MODERN
THERMODYNAMICAL CONSIDERATIONS.

(Order No. 61-3097)

Ollin Junior Drennan, Ph.D.
The University of Wisconsin, 1961

Supervisor: Associate Professor Erwin N. Hiebert

The purpose of this study was to trace the development of electrolytic solution theory from its beginning with the discovery of the voltaic pile in 1800 to its culmination in the work of Nernst in 1889, special attention being given to thermodynamic treatments and their importance to electrolytic solution theory.

The explanations of the internal nature or composition of an electrolyte and the source of the electromotive force were traced through their evolution. Grothuss gave the first qualitative explanation of the means by which a current traversed a solution in his theory of the decomposition chain in 1805. The work of Clausius in 1857 and Arrhenius in 1887 provided the modern electrolytic dissociation theory.

The speculations of Faraday which were based on great experimental ingenuity provided several clues to the source of the electromotive force as well as supplying the quantitative laws of electrolysis. The problems of electrolytic polarization and ionic motion in solutions led to the experimental work of Helmholtz and Kohlrausch.

Thermodynamic analysis was brought to bear upon the source of the electromotive force in 1877 when Helmholtz derived an equation relating the electromotive force of a concentration cell to the different concentrations of the electrolyte at the electrodes. Dissatisfaction over the lack of information contained in the thermodynamic treatment concerning the mechanism taking place in the cell led Nernst to derive essentially the same mathematical relationship for the concentration cell in 1889 from the basic assumption of van't Hoff. He assumed that dissolved molecules act in a manner analogous to gaseous molecules. Osmotic pressure became the basis for Nernst's development and led to the introduction of the concept of the electrolytic solution pressure.

The judgment that Nernst's explanation was the first satisfactory one was based on the fact that it included the basic generalizations of van't Hoff and Arrhenius and as a result combined the explanation of many dissimilar phenomena in one theoretical structure.

Gibbs and Helmholtz extended theoretical thermodynamics between 1876 and 1883 by introducing the concepts of thermodynamic potential and free energy respectively and made applications to electrolytic solution theory.

These applications were to prove exceedingly important in later theoretical advances but were not quickly assimilated by contemporary chemists.

The demonstration of this reluctance on the part of physical chemists in 1889 to adopt an exclusively mathematical analysis and the preference for an explanation based on a microscopic process was one of the results of this study. A second result was the delineation of the contributions made to a satisfactory theoretical explanation by increased competence in experimental procedures and techniques, by the adoption of a kinetic theory of matter and the increased use of mathematics.

The fruitfulness of thermodynamic application was shown in this study by the analysis of the work of Gibbs and Helmholtz. In the light of the predominate role played by thermodynamics in electrolytic solution theory today, the final conclusion of the study was that general utilization of thermodynamic reasoning in electrolytic studies by physical chemists occurred later than 1889, the terminal date of this study, and that the modern theory which depends so completely on thermodynamic considerations was not developed until after an adequate explanation of electrolytic phenomena had been given by Nernst.

Microfilm \$2.95; Xerox \$10.15. 225 pages.

CHEMISTRY, ANALYTICAL

COPRECIPITATION WITH URANOUS OXALATE

(Order No. 61-3297)

Jacob Block, Ph.D.
Case Institute of Technology, 1961

The technique of precipitation from homogeneous solution was used to study the coprecipitation of scandium(III) and cerium(III) individually with uranous oxalate hexahydrate. These systems followed the logarithmic distribution law more closely than the homogeneous distribution law. The coprecipitation of scandium(III) with uranous oxalate resulted in an apparent high degree of coprecipitation in the early stages, which could be significantly reduced by the prior addition of carrier crystals to the system. The cerium(III)-uranous oxalate system followed the logarithmic distribution law modified for ionic charge differences between carrier and tracer. The logarithmic distribution coefficient was found to be a ratio of the fractional rates of precipitation of tracer and carrier respectively; while the type of distribution expression followed is believed to be functionally related to the kinetics of the precipitation process.

Microfilm \$2.75; Xerox \$4.80. 94 pages.

THE ALKYLATION OF NAPHTHALENE NEGATIVE ION

(Order No. Mic 61-1903)

Francis Ross Galiano, Ph.D.
Washington University, 1961

Chairman: Professor David Lipkin

The reaction of the naphthalene negative ion with ethyl sulfate was studied in detail. Sodium naphthalenide in tetrahydrofuran, dimethoxyethane and dioxane, and lithium naphthalenide in tetrahydrofuran reacted with ethyl sulfate to give mixtures of alkylated dihydronaphthalenes. The components of these mixtures were separated by means of a large scale vapor fractometer constructed in this laboratory. The primary reaction products were 1,2-diethyl-1,2-dihydronaphthalene and *cis*- and *trans*-1,4-diethyl-1,4-dihydronaphthalenes. Only one isomer of 1,2-diethyl-1,2-dihydronaphthalene was observed. Small amounts of α - and β -monoethylnaphthalenes were also formed. Some of the 1,4-diethyl-1,4-dihydronaphthalenes were further alkylated during the course of the reaction to give 1,1,4-triethyldihydronaphthalene and 1,2,4-triethyldihydronaphthalene. Nuclear magnetic resonance spectroscopy was used rather extensively in structure proofs. The two 1,4-diethyl-1,4-dihydronaphthalenes were assigned *cis* and *trans* configurations on the basis of their nuclear magnetic resonance spectra. While 1,2-diethyl-1,2-dihydronaphthalene was found to be relatively stable to air oxidation, both 1,4-diethyl-1,4-dihydronaphthalenes formed peroxides when exposed to air at room temperature for several days.

Quantitative analyses of the mixtures were carried out both by direct weighing of samples off the large vapor fractometer and by area determinations on analytical vapor chromatographic curves. The relative amounts of 1,2 and 1,4 products were found to be a function of the solvating power of the ether solvents used but appeared to be independent of the metal ion. The ratio of 1,4 product to 1,2 product increased in the order: dioxane < tetrahydrofuran < dimethoxyethane. The ratio of the negative ion to the sodium naphthalenide ion-pair in these solvents increases in the same order. The relative amounts of 1,2 product and 1,4 product were shown to be related to the amount of primary attack of the ethyl sulfate at the α and β positions of the naphthalenide ion or ion-pair. It is suggested that the proximity of the sodium ion to the naphthalenide ion was responsible for the increased β attack in tetrahydrofuran and, especially, dioxane solution.

The reaction of 1,3-dichloropropane with sodium naphthalenide in dioxane resulted in the formation of 1,2-cyclopentano-1,2-dihydronaphthalene in 39% yield. 1,4-Dichlorobutane reacted with naphthalene negative ion in dioxane solution to give 1,2,3,4,11,12-hexahydrophenanthrene in 36% yield. These reagents reacted exclusively at the number one and number two positions. No bridged ring (1,4) products or rearranged products were observed. No bridged or cyclized products were observed from the reaction of ethylene sulfate with naphthalene negative ion in tetrahydrofuran. 1-Ethylnaphthalene was isolated from the reaction product in 13% yield. No 2-ethylnaphthalene was formed. The major products from the reaction of 1,5-dichloropentane with sodium naphthalenide in dioxane solution were 1-n-amyl-naphthalene and 2-n-amyl-naphthalene. No bridged or cyclized products were observed.

Microfilm \$2.75; Xerox \$6.40. 131 pages.

THE DIRECT MICRODETERMINATION OF OXYGEN IN ORGANIC COMPOUNDS

(Order No. 61-3286)

Richard Robert Suchanec, Ph.D.
University of Pittsburgh, 1961

In this investigation, two combustion methods for the microanalysis for oxygen in organic compounds were explored. One of the methods studied dealt with a gravimetric treatment of the combustion products while in the other, the pyrolysis products were determined by a gas-solid chromatographic procedure.

The gravimetric approach involved combustion of an organic sample in an atmosphere of nitrogen over quartz chips at 800°C. and copper oxide at 600°C. Water and carbon dioxide, which were the only oxygen-containing products, were absorbed in separate tubes and subsequently weighed along with the copper oxide-packed tube. The oxygen in a sample was calculated from the sum of the gains in weight of the water- and carbon dioxide-absorbing tubes, converted to oxygen, minus the loss in weight of the copper oxide tube.

An extensive study of the operational blanks attributed to each of these tubes and the proper conditions to minimize them were investigated, as were the experimental parameters of the combustion process. The best features of the blank studies were incorporated into an analysis procedure which subsequently proved to be more applicable to the semimicro-range of sample sizes. Five separate weighings were required for successive analyses of individual samples, assuming that the operational blank had been determined. A single analysis was completed in 55 minutes. Results for five benzoic acid samples using this procedure had a mean of 26.49% of oxygen with a standard deviation of $\pm 0.71\%$. Similar analyses of eight dextrose samples had a value of 54.19% oxygen with a standard deviation of $\pm 1.12\%$. The theoretical values for these compounds are 26.21% and 53.28%, respectively.

In order to minimize the total weighing time that was a part of the gravimetric procedure, a modified single-deflection method of weighing was developed for use with a microchemical balance. This technique was found to have higher precision and be more rapid than other existing methods when these various weighing procedures were used concurrently during actual elemental microanalyses.

The second combustion method studied was based on the complete reduction of a sample by carbon in an atmosphere of helium. A quartz combustion tube packed with carbon and heated to 1120°C., and a similar tube packed with a 1:1 by weight platinum-carbon mixture and heated to 920°C., were checked for applicability to a general analysis scheme.

The oxygen of the original sample was converted to carbon monoxide which was ultimately determined directly by gas-solid chromatography, a completely new approach to the microdetermination of oxygen in organic compounds.

A specially constructed sample-collecting loop which was packed with Molecular Sieve 5A was used for the quantitative capture (at -78°C.) and subsequent release (at 300°C.) of the carbon monoxide produced in the combustion process. The loop was calibrated and used as a sample by-pass injection system for the gas chromatographic unit. The molecular sieve-packed column resolved carbon monoxide from other gases, and its thermal conductivity

relative to helium was measured by the conductivity cell whose output was fed directly to a recorder which traced the chromatogram of the carbon monoxide peak. The area of this peak was measured with a planimeter and was used as a quantitative measure of the oxygen in the original sample. This latter value was calculated from a previously determined conversion factor of 8.66 μ g. of oxygen per planimeter vernier unit.

After an extensive study of the operational blank, the best pre-purifier for helium was found to be a molecular sieve trap at -78°C . or lower. Proper pretreatment and conditioning of the combustion tube packing also aided in the attainment of a low, reproducible blank value of 0.026 mg. of oxygen per 250 ml. of helium.

A final analytical method for the microdetermination of oxygen in organic compounds based on the combustion-chromatographic process was devised using 1:1 platinum-carbon at 920°C . This method was found to be applicable to analyses of compounds which contained oxygen, hydrogen, carbon, sulfur, nitrogen, chlorine, and/or bromine, when copper gauze heated to 920° was also included in the combustion tube packing. Phosphorus and fluorine-containing compounds did not give good results.

The sensitivity of this method is shown by the standard deviation of $\pm 0.17\%$ oxygen for nine benzoic acid samples which required a 35-minute analysis time for successive determinations.

Microfilm \$2.75; Xerox \$7.00. 148 pages.

CHEMISTRY, BIOLOGICAL

FURTHER INVESTIGATIONS OF THE AMINO ACID NUTRITION OF THE DOMESTIC FOWL

(Order No. 61-3076)

James Scott Adkins, Sr., Ph.D.
The University of Wisconsin, 1961

Supervisors: Professors A. E. Harper and
M. L. Sunde

Investigations have been made in the area of amino acid nutrition of growing and mature domestic fowl using a highly purified diet in which the nitrogen was supplied solely by crystalline amino acids. Two Single Comb White Leghorn (S.C.W.L.) pullets and two hens in their second laying year were maintained for over 6 months on an amino acid (AA) diet containing 3.2% N supplied by glycine and indispensable AA's. Birds fed this diet averaged 74, 31, 64, and 62% production respectively for the first 6 weeks. Birds fed a control diet averaged 61.9%. Body and egg weights were maintained but the weights of eggs from control birds increased 1.8 grams in 6 weeks. No differences in Haugh units were observed in 150 eggs examined. The average 4-week weight of chicks from dams fed the AA diet was 25 grams more than that of control chicks when all were fed a practical chick ration. The AA mixture proved adequate for normal feathering of hens. Reducing the levels of 9 of the 13 AA's by 60% resulted in a decrease

of 8.5% in production, a 3.4 gram decrease in egg weight but no loss in body weight. No change in the production of one pullet resulted from a 20% reduction of these AA's. The four birds laid 98, 66, 94, and 60 eggs respectively for 24 weeks, including 8 weeks on the 60% regimen; the controls averaged 97 eggs.

Three experiments, of 5, 7, and 8 weeks, were conducted to quantitatively estimate the L-arginine requirement of the laying pullet. A total of 64 S.C.W.L. pullets were fed purified diets containing the equivalent of 10.8, 12.7 or 20.8% protein (N X 6.25) supplied by 3 or 5% lactalbumin, 4 or 8% casein, glycine and indispensable amino acids. In one experiment 2.5% zein was added. Graded levels of L-arginine-HCl were included in the diets already containing 0.27 or 0.5% L-arginine. Pullets fed 0.6% L-arginine (free base) and higher levels averaged 58% production as compared to 26% production for birds fed levels below 0.6%. Pullets fed a casein-gelatin diet averaged 64% production. Feeding 0.27% L-arginine resulted in a cessation of egg production within one week. Body weight and egg weight were maintained by feeding 0.56% L-arginine. The level of arginine had no effect on hatchability and the average four-week weight of chicks from dams fed 0.5% L-arginine was comparable to that of control chicks when all were fed a practical ration. When all the above measures are considered, it appears that the L-arginine requirement of the hen is between 0.6 and 0.7% of the diet.

A free AA diet has been developed which supports chick growth of approximately 7 to 12 grams a day. The diet contains the equivalent of 20% protein (N X 6.25) supplied solely by the indispensable AA's for the chick plus L-tyrosine and L-glutamic acid. Day-old or week-old New Hampshire X S.C.W.L. or commercial broiler type chicks were fed this AA diet *ad libitum* for 2 to 4 weeks. A feed grade D-allo L-isoleucine was found to be only about 25% active for the chick. A mixture of five dispensable AA's including 1% L-proline added to the AA basal diet containing 4% L-glutamic acid gave an increased gain of 1 gram/day for 2 weeks. The addition of 1.5% L-proline singly or in a mixture to the AA basal containing 7% L-glutamic acid gave no growth response. A severe growth depression observed by feeding 2.5% DL-alpha alanine singly or in a mixture was not noted with the corresponding L-isomer or with 1.5% DL-alanine. After the second week, growth of chicks fed the AA diets dropped substantially (average 35 grams) below that of chicks fed a supplemented purified diet consisting of 20% casein or 20% casein-8% gelatin.

Microfilm \$2.75; Xerox \$4.80. 93 pages.

SORGHUM α -AMYLASE: ISOLATION AND PROPERTIES.

(Order No. 61-3008)

Shyam Kumar Dube, Ph.D.
Kansas State University, 1961

Amylases have been the subject of extensive investigation for many years, however, the finer mechanistic details of amylase action are still far from being understood. The present investigation was undertaken to add, by experimentation, further information on the mechanism of

action of an α -type amylase. It was desired also to explore an amylase system, the chemistry of which has not yet been well defined, and to isolate a new α -amylase for investigation. Sorghum was such a readily available source material.

The presence of α - and β -amylases in sorghum malt was confirmed. The β -amylase was found to be more thermostable than the α -component and could not be preferentially inactivated by heat treatment. α - and β -amylases, however, could be separated on a starch column. A purification procedure for α -amylase was worked out based on ultra-centrifugation, salt fractionation and adsorption on starch granules. The purified enzyme had a specific activity comparable to crystalline barley α -amylase. A pH optimum of 4.6 was noted; also very comparable to barley α -amylase. A calculation of pKa and pKb by Alberty's method indicated a probable involvement of carboxyl and imidazole groups in the active site of the enzyme. Evidence for the metal ion requirement by α -amylase was obtained. It appears that calcium is bound to enzyme protein in a manner similar to other α -amylases. The energy of activation of α -amylase reaction was found to be 7410 calories. Q_{10} values indicated that the reaction rate increases with increase in temperature. However, at higher temperatures a loss in activity occurs due to denaturation of enzyme protein.

Action of α -amylase on amylose, soluble starch, Naegeli dextrans, and waxy maize starch was studied. The products of enzyme reaction were found to comprise a mixture of malto dextrans of which a preponderance of malto-octaose, -heptaose, and -hexaose was noted. Dextrans smaller than maltohexaose were found in relatively low concentrations. Small amounts of maltononaose were also present. Glucose was found in mere traces only near the achroic point. Low molecular weight branched dextrans could not be observed at the achroic point even when waxy maize was used as the substrate. Evidence indicates that sorghum α -amylolysis is not a completely random process. The eighth link from the ends of a polysaccharide chain is preferentially attacked by the enzyme. Linkages within this distance are attacked with decreasing preference. The first linkage from the ends of a chain is highly resistant to enzymic attack.

Hydrolysis of amylose, soluble starch, Naegeli dextrans, and waxy maize starch was followed by measuring at intervals the iodine spectra of reaction mixtures. In all cases, a shift in λ_{\max} toward lower wavelengths was observed. A dependence of the magnitude of shift on the length of polymer chains was also noted. Evidence indicates that the enzyme operates predominantly by a multi-chain mechanism. The reaction was found to be very rapid in the early phases decreased with the progress in hydrolysis. The rapid phase corresponded to the time during which λ_{\max} of the reaction mixture-iodine complex was above 500 m μ , indicating a preference for long chain polymers. Evidently when the average chain length falls below 10-15 units, the reaction is relatively slow. It was found that the branching tends to hinder enzymic action. With the same concentration of enzyme and substrate, about twice as much time was required to reach the achroic point, in the case of waxy maize starch as in the case of amylose. This may be ascribed to differences in structure. Amylose, being a linear polymer, offers to the enzyme a more uniform and more easily accessible structure

than does waxy maize starch which is a highly branched polysaccharide.

Microfilm \$2.75; Xerox \$4.20. 80 pages.

QUANTITATIVE AND QUALITATIVE DETERMINATIONS OF THE ESTROGENS OF THE BOVINE OVARY

(Order No. 61-3009)

Bert Hazen Erickson, Ph.D.
Kansas State University, 1961

This study was undertaken to quantitate and qualitate the estrogenic contribution of the component parts of the bovine ovary during the gravid and nongravid state. All quantitative information was gained through the castrate mouse uterine weight method of bioassay. Qualitative information was derived through a system of paper chromatography.

Ovaries were obtained from apparently normal parous cows at Armour and Company's Kansas City Abattoir and placed in one of the following five categories: 1, nonpregnant, 2, pregnant 1-70 days 3, pregnant 70-142 days 4, pregnant 142-214 days and 5, pregnant 214-283 days. These categories were based on the state of the uterus or crown-rump measurement of the fetus.

Ovarian follicles were assigned to class I, II or III depending on the volume of aspirated follicular fluid (class I, 0.01-0.20 ml; II, 0.2-0.6 ml and III, 0.6-1.5 ml). Follicle walls were removed from class II and III follicles and the corpora lutea were excised creating a residual ovarian tissue category.

Quantitative determinations on follicular fluid revealed that in all reproductive stages measured fluid from class I follicles was of least potency and fluid from class II follicles of greatest potency. Due to the preponderance of class I follicles during both gravid and nongravid states their contribution to the ovarian estrogen pool is assumed to be important.

Assays of follicle walls indicated that the estrogenic activity of tissue obtained from class III follicles was greater in all cases measured than tissue derived from class II follicles. This discrepancy in estrogenic potency between the follicle's fluid and its wall is believed to be due to a reservoir effect exerted by the wall of class II follicles and thus may cast some doubt upon the assumption that the estrogenic potency of the follicular fluid is a true reflection of the activity of the follicle wall.

The estrogenic content of residual ovarian tissue was highest in the nongravid state (0.84 μ g/100 gm tissue) and decreased as gestation advanced (0.11 μ g/100 gm). A similar pattern was noted in the case of the follicle. Follicle numbers declined sharply with advancing gestation and as a consequence inadequate numbers of class II and III follicles were available to permit an estrogenic evaluation of these follicle classes in the most advanced stage of gestation.

A surprising increase in the estrogenic potency of corpora lutea was observed with advance in the stage of gestation (0.06 μ g/100 gm at the interval 1-70 days of gestation and 0.27 μ g/100 gm at the most advanced stage, i.e., 214-283 days of gestation).

Estrone and 17 β -estradiol were tentatively identified in the extract of 1768 gm of whole ovaries. Other efforts with paper chromatography produced negative results.
Microfilm \$2.75; Xerox \$3.00. 57 pages.

A PRELIMINARY INVESTIGATION INTO THE CHEMICAL NATURE OF THE Rh ANTIGENS

(Order No. Mic 61-1105)

Donald Lee Everhart, Ph.D.
Boston University Graduate School, 1961

Major Professor: Dr. William C. Boyd

The inhibition technique was used in an attempt to determine the chemical structure of Rh antigens. A saline agglutinating Rh antibody was mixed with a chemical compound of known structure, containing carbohydrate, and believed to be similar in configuration to the Rh antigen in question. This mixture was first incubated, then the appropriate erythrocytes were added. Following a second incubation, the degree of agglutination was read in the usual manner for Rh testing. A saline control was carried out for each experiment. If the unknown showed less agglutination than the control, then the chemical compound was said to have an inhibitory effect. In all these experiments the inhibitor was diluted and not the antibody.

The three Rh antibodies, anti-C, anti-D, and anti-E, were tested with the same carbohydrates, D- and L-glucose, D- and L-mannose, D-ribose, and L-lyxose. The antibodies were also tested with antibiotics which included streptomycin, stylomycin, carbomycin, and two degradation products of the first two, streptobiosamine and 6-dimethyl-amino-9-(3'-amino-3'-deoxy-beta-D-ribofuranosyl)-purine. Some of the above carbohydrates and streptobiosamine were coupled with aniline and p-aminophenol, and then tested as inhibitors. 5'-adenylic acid and 2', 3'-adenylic acid were also tested as inhibitors. Their reactions suggested the use of indol acetic acid and indol butyric acid. Two amino acids, tyrosine and phenylalanine, were tested. In addition, p-aminophenyl acetic acid and salicin were also used as inhibitors.

Anti-C was found to be inhibited by the following compounds:

p-hydroxy-N-phenyl-D-mannosylamine	0.025M
p-hydroxy-N-phenyl-D-ribosylamine	0.025M
Stylomycin	0.05 M
L-lyxose	0.05 M
Indol acetic acid	0.05 M
Indol butyric acid	0.05 M
Streptomycin	0.1 M

The lowest concentration of the substance which gave complete inhibition is given. Since L-lyxose is the only pure carbohydrate in the table, it is believed that this may be the most important component in the C antigen. Thus, C antigen may have L-lyxose as the terminal group coupled to p-aminophenol through the amino group.

Anti-D was found to be inhibited by the following:

p-hydroxy-N-phenyl-D-mannosylamine	0.0008M
p-hydroxy-N-phenyl-D-ribosylamine	0.0015M

5'-adenylic acid	0.006 M
2', 3'-adenylic acid	0.006 M
Indol butyric acid	0.006 M
Indol acetic acid	0.012 M
Colominic acid	0.012 M
Salicin	0.05 M
Streptomycin	0.1 M
Stylomycin	0.1 M
D-ribose	0.2 M
L-lyxose	0.2 M

On the basis of these reactions it is believed that the D antigen is a branched antigen and may have as one terminal unit a carbohydrate coupled to p-aminophenol which, in turn, is coupled to a purine. Colominic acid is probably present in the other branch even though the terminal group is unknown.

Anti-E was inhibited by the following compounds:

5'-adenylic acid	0.0025M
2', 3'-adenylic acid	0.0025M
p-aminophenyl acetic acid	0.006 M
Streptomycin	0.025 M
Stylomycin	0.05 M
Streptobiosamine	0.1 M

These reactions suggest that the E antigen may contain p-aminophenyl acetic acid as the terminal unit coupled to a carbohydrate.

An attempt was made to produce a synthetic Rh-like antigen by coupling either rutin, found by Boyd, McMaster, and Waszczenko-Zacharczenko (1959) to inhibit anti-D, or streptobiosamine to dog serum and injecting these compounds into rabbits. Although antibodies were produced, they did not react specifically with the Rh antigen.

Microfilm \$2.75; Xerox \$5.80. 119 pages.

DILUTE ACID HYDROLYSIS AND STRUCTURAL STUDIES OF HUMAN SERUM ALBUMIN

(Order No. 61-3581)

George Franklin Grannis, Ph.D.
Temple University, 1961

The investigation of the chemical structure of the large proteins (molecular weights greater than 50,000) requires highly specific protein degradative procedures. There are few such methods presently available, and prior to initiating structural studies of a given protein, the applicability of available methods should be carefully evaluated. In the present work, the specificity and potential usefulness of dilute acid hydrolysis alone and in conjunction with tryptic digestion has been investigated; the results obtained provide evidence that the combined use of these methods of hydrolysis provides a feasible approach to the determination of the chemical structure of human serum albumin.

In dilute acid solutions, aspartic acid is preferentially released from proteins. The specificity of dilute acid hydrolysis under carefully controlled conditions was evaluated using as a model compound insulin, which contains two internally situated asparagine residues and one C-terminal asparagine residue. From the changes which occurred in the concentration of free aspartic acid, ammonia

(arising from the hydrolysis of amide bonds), and amino nitrogen throughout the course of hydrolysis, evidence was obtained for the quantitative cleavage of asparagine and glutamine amide bonds, and of aspartic acid peptide bonds. The determination of N-terminal residues in partial hydrolysates revealed that, except for some cleavage of serine and threonine bonds, peptide bonds of other amino acids were not split. From such findings it appeared that dilute acid hydrolysis might be useful in structural studies of those proteins with a low ratio of hydroxy-amino acids to aspartic acid.

As human serum albumin has a favorable ratio of hydroxy-amino acids to aspartic acid, its hydrolysis in dilute acid was investigated. Amide and aspartic acid peptide bonds were quantitatively cleaved and evidence was obtained for little cleavage of other peptide bonds. By examining fragments formed during albumin hydrolysis, additional evidence was obtained concerning the specificity of dilute acid hydrolysis. Two fractions were partially characterized; one appeared to be a single peptide having the structure Arg.Glu.(Glu₃,Ala₂,Leu or Ileu, Phe, Ala) Val.Leu or Ileu., and was recovered in high molar yield (0.91 moles per mole of albumin). A second fraction appeared to be composed of a family of peptides, which was derived from a single large peptide consisting of two polypeptide chains joined by two disulfide bonds. The latter structure represented about ten percent of the total albumin molecule.

As the determination of the chemical structure of a large protein requires the use of at least two specific methods of protein degradation, the tryptic digestion of albumin was investigated, particularly in regard to its usefulness in conjunction with dilute acid hydrolysis. The results obtained show that tryptic digestion and dilute acid hydrolysis are not entirely satisfactory procedures for the study of albumin structure; however, it should be possible to elucidate a considerable portion of the albumin structure by their combined use.

Microfilm \$2.75; Xerox \$7.00. 146 pages.

SPECIFICITY OF MILK LIPASES

(Order No. 61-3112)

Venktesh Rangrao Harwalkar, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Harold E. Calbert

The purpose of this investigation was to determine if lipases in milk exhibit any fatty acid specificity. To achieve this aim relative proportions of groups of individual fatty acids, liberated from milk fat by lipases of milk, were measured.

A preliminary indication regarding the variation in the relative amounts of volatile and non-volatile fatty acids, released during various stages of induced lipolysis, was obtained by steam distillation of milk. A similar variation in the proportion of water soluble and water insoluble fatty acids was observed during lipolysis when the acid degree was determined by different methods that varied in their ability to recover short-chain and long-chain fatty acids. However, more definite information regarding the specifi-

city of lipases was sought through analyses of the free fatty acids for some of the individual acids.

A procedure for the analysis of the free fatty acids based on partition chromatography developed by Ramsey and Patterson and as modified by Kemp and Hetrick (J. Dairy Sci., 1958) was used. The free fatty acids were isolated from milk by a modified wet-ether extraction procedure and removed as their sodium salts by washing the extract several times with dilute aqueous alkali. The washings were concentrated to obtain a dry powder. The fatty acids, after regeneration from their salts, were separated by silicic acid column chromatography to obtain five fractions: "lauric and higher," capric, caprylic, caproic and butyric acid.

Analysis of the free fatty acids released from milk fat during lipolysis induced by homogenization and temperature activation treatment showed that all the five fractions of fatty acids were liberated. However, the "lauric and higher" fraction was the major fraction released at all stages of lipolysis. The changes in the mole percentages of the different fatty acid fractions were similar during homogenization or temperature activated lipolysis. Generally, as the lipolysis progressed a gradual decrease in the mole percentage of "lauric and higher" fraction and a steady rise in the mole percentage of the butyric fraction was observed. The mole percentages of capric, caprylic and caproic acid were not altered to any appreciable extent.

A lack of high degree of specificity of milk lipases was evident from the relatively small changes in the relative proportions of the different fatty acids liberated. Nevertheless, a slight degree of selectivity of milk lipases toward the release of short-chain fatty acids, especially butyric, was observed. This selectivity of lipases was more marked when the lipolysis was extensive.

The selectivity of lipases towards short-chain fatty acids observed upon extensive lipolysis, could not be explained in terms of the differences in the specificity of enzymes, since the changes in the relative amounts of the different fatty acids released during lipolysis induced after treatment of milk with formaldehyde or after addition of "membrane" lipase or "plasma" lipase, were similar to the changes produced by whole milk at comparable levels of lipolysis.

Microfilm \$2.75; Xerox \$5.60. 112 pages.

HYDROXYPYRUVIC ACID: CHEMICAL AND ENZYMATIC STUDIES.

(Order No. 61-3113)

Jerry Leo Hedrick, Ph.D.
The University of Wisconsin, 1961

Supervisor: Associate Professor H. J. Sallach

Hydroxypyruvic acid is known to participate in a large number of enzymatic reactions. However, its metabolic origin and final catabolic fate remain unknown. While studying the metabolism of hydroxypyruvic acid, it was found that it readily undergoes certain nonenzymatic reactions. The nonenzymatic reactions of hydroxypyruvic acid have been studied under the mild conditions used in

enzymatic studies. The research undertaken can be divided into three parts: 1) hydroxypyruvic-alanine transaminase, 2) the nonenzymatic reactions of hydroxypyruvic acid, and 3) the enzymatic oxidation and decarboxylation of hydroxypyruvic acid.

1) The presence of hydroxypyruvic-alanine transaminase in different animals has been studied. This transaminase was found to be present in the livers of all the animals studied, including humans, with the relative amounts of the enzyme varying some 25 fold.

2) Hydroxypyruvic acid is a labile compound under the mild conditions employed in enzymatic experiments. It readily undergoes autoxidation and decarboxylation, both of which are promoted by alkali. Metals increase the rate of autoxidation of hydroxypyruvic acid. Decarboxylation, on the other hand, is increased by some metals and decreased by others. This finding is consistent with the mechanisms proposed for autoxidation and decarboxylation. The mechanism makes use of the tautomerism of hydroxypyruvic acid to dihydroxyacrylic acid and tartronic acid semialdehyde which is promoted by alkali and metals. The tautomer, dihydroxyacrylic acid, is the compound which undergoes autoxidation. This compound can also apparently form a chelate with certain metals. These chelates are capable of undergoing autoxidation, but in instances where the metals used form highly stable chelates, chelation prevents further tautomerism to the compound decarboxylating which is tartronic acid semialdehyde.

The autoxidation of dihydroxyacrylic acid leads to the formation of H_2O_2 and ketomalonic acid semialdehyde. The decarboxylation of tartronic acid semialdehyde leads to the formation of CO_2 and glycolaldehyde. Thus, the autoxidation and decarboxylation commonly ascribed to hydroxypyruvic acid have been found not to be taking place with this compound itself, but rather with its tautomeric forms.

3) Comparative studies on the enzymatic oxidation and decarboxylation of hydroxypyruvic acid and pyruvic acid have indicated that these compounds are following different routes of oxidation and decarboxylation in washed residue preparations from rat liver. Pyruvic acid oxidation was found to be dependent on the addition of DPN to the enzyme preparations, completely inhibited by arsenite, and sensitive to a state of thiamine deficiency in the animal. Hydroxypyruvic acid oxidation, on the other hand, was unaffected by added DPN, arsenite, or a state of thiamine deficiency. Its decarboxylation was found to be independent of added DPN, and only slightly affected by addition of arsenite or a state of thiamine deficiency. Thus hydroxypyruvic acid is not entering into the same metabolic pathways to any large extent that pyruvic acid is in these preparations. These preparations have been found to catalyze the oxidation and non-oxidative decarboxylation of hydroxypyruvic acid distinct from systems for the oxidation and decarboxylation of pyruvic acid. The oxidation and decarboxylation of hydroxypyruvic acid are two separate and divergent, rather than sequential, reactions. Preliminary evidence suggests that a flavin derivative may be involved in the oxidation of hydroxypyruvic acid.

Microfilm \$2.75; Xerox \$4.00. 75 pages.

β -HYDROXYASPARTIC ACID: ITS CHEMICAL AND BIOLOGICAL PROPERTIES.

(Order No. 61-3126)

Margaret Livens Kornguth, Ph.D.
The University of Wisconsin, 1961

Supervisor: Associate Professor Henry J. Sallach

The following investigations have been carried out as a part of a project designed to understand the role of hydroxyaspartic acid in biological systems. A new synthesis of hydroxyaspartic acid has been achieved by a condensation of copper glycinate with sodium glyoxylate in an alkaline medium. The identity of the product has been established by elemental analysis and by other chemical tests. Both of the diastereoisomers of hydroxyaspartic acid were produced by the above synthesis. They have been separated on ion exchange columns and their steric configuration has been established on the basis of previous experiments.

The stability of both diastereoisomers has been studied in several solvents. Under the conditions conventionally employed for protein hydrolysis (i.e., 6N HCl at 120°C for 24-48 hours), the erythro and threo isomers of hydroxyaspartic acid are not appreciably decomposed, contrary to previous reports. However, under these conditions interconversion of the diastereoisomers occurs, resulting in a ratio of five parts erythro to three parts threo at equilibrium. The diastereoisomers of hydroxyaspartic acid are also interconverted in a hot aqueous solution at pH 3.3. In this case the threo form predominates at equilibrium. Heating in water leads to a partial decomposition of hydroxyaspartic acid, as evidenced by the appearance of considerable amounts of glycine and free ammonia in the reaction mixture. When exposed to hot base, hydroxyaspartic acid undergoes the α,β cleavage typical of β -hydroxy- α -amino acids to give glycine as the main ninhydrin positive degradation product.

Having both diastereoisomers of hydroxyaspartic acid available, it has been possible to establish which of these participates in specific enzymatic reactions. Only the erythro isomer has been found to serve as substrate in transamination and transcarbamylation reactions; only the threo isomer acts as substrate in the amino acid activation reaction. The reason for this difference in reactivity has not been elucidated.

For the specific identification of hydroxyaspartic acid in natural sources the following criteria have been established: 1) cleavage upon treatment with periodate with the liberation of ammonia, 2) conversion to the other diastereoisomer in hot acid or water at the established rate, and 3) decomposition to glycine in base. An amino acid isolated from a pancreatic digest of casein has met the above criteria. In addition it has reacted as authentic erythro-hydroxyaspartic acid in two specific enzymatic and several chromatographic systems. On the basis of these results it has been concluded that the isolated material is in fact erythro-hydroxyaspartic acid. Studies on acid hydrolysates of proteins have shown a component with the same chromatographic migration as hydroxyaspartic acid. This material has not met the above established criteria, therefore it has been concluded that it is not hydroxyaspartic acid.

A thorough understanding of the chemical and biological properties of hydroxyaspartic acid would not be complete

without an investigation of its possible derivatives. Therefore the following compounds have been synthesized, characterized and studied: O-phosphorylhydroxyaspartic acid, α - and β -hydroxyasparagine, and two hydroxyaspartyl dipeptides. The chromatographic migration of these compounds has been determined in several systems. Hydrolytic studies have shown that the stability of the hydroxyaspartic acid moiety in these derivatives is the same as determined for the free amino acid.

The information derived from these investigations has expanded the understanding of the properties of hydroxyaspartic acid and its derivatives. It should act as a valuable aid toward a clearer elucidation of the biological role of these compounds.

Microfilm \$2.75; Xerox \$4.60. 89 pages.

THE BIOLOGICAL PROPERTIES OF SYNTHETIC POLYPEPTIDES AND POLYPEPTIDYL PROTEINS

(Order No. 61-3127)

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The University of Wisconsin, 1961

Supervisor: Professor Mark A. Stahmann

Polyanions and Trypsin Activity: The effect of various polyanions on the protease and amidase activity of trypsin was studied. Poly α -L-glutamic acid, polycysteic acid and heparin inhibited trypsin activity at low polyanion concentrations, but restored tryptic activity at high polyanion concentrations. Poly γ -D-glutamic acid did not do this. The inhibition of the hydrolysis of denatured proteins and benzoylarginine amide by the polyanions is the result of formation of a complex of the polyanion with the enzyme. Inhibition of trypsin activity by polyglutamic acids of different molecular weights is a function of the ratio of the enzyme to the total number of anionic groups of the polypeptide. Those polyanions in which the ionic residues are separated by a multiple of the distance between residues of an extended polypeptide complex with trypsin to inhibit its hydrolytic activity. A single polyanion may combine with basic groups of the enzyme on opposite sides of the active site. Native proteins such as serum albumin which have a high affinity for the enzyme or polyanion may displace the polyanion. In excess polyanion the basic groups on opposite sides of the active center combine with different polyanion molecules, which allows the substrates to reach the active site.

Titration of Polypeptidyl Proteins: pH titration curves of bovine and rabbit albumin which had been modified by the chemical attachment of polypeptides of glycine, leucine, phenylalanine, glutamic acid or lysine were determined by a micro continuous titration method. The number of polypeptide chains added and the average chain length were calculated.

Immunochemistry of Polypeptidyl Proteins: Quantitative precipitation studies of the antibodies produced in response to the immunization of rabbits with bovine albumin modified by the addition of peptides of glutamic acid,

lysine, leucine, phenylalanine indicated that some of these antibodies were specific for the carrier protein, others for the added polypeptide, and that some required both the modification and a part of the carrier protein. Quantitative studies on the sera prepared against similarly modified rabbit albumins indicated that there were antibodies specific for the added polypeptide, and some which required a portion of the carrier protein and the modification. Absorption experiments on antisera to the modified bovine albumins indicate that similarly modified rabbit albumins precipitate all the antibodies produced in response to the added polypeptide, but that unmodified bovine albumin does not precipitate all of the antibodies.

Effect of Polylysine on the Cytology and Leakage and Retention of Compounds by Ehrlich Ascites Tumor Cells: Washed Ehrlich ascites cells were suspended in either a saline or a polylysine saline solution. The cells were centrifuged and the supernatant above the polylysine treated or control cells or the cell pellet was studied. With the use of a fluorescent polylysine derivative it was shown that the polycation bound the lipoprotein surface of the tumor cell and did not penetrate the cell membrane to any appreciable extent within 10 minutes. Following polylysine treatment the mitochondria and nuclei were found near the cytoplasmic membrane, the cytoplasmic ribonucleic acid and protein and the nuclear chromatin was aggregated. Inorganic phosphate, carbohydrate, free amino acids, small peptides, potassium and 5' adenosine monophosphate were released from the tumor cells into the supernatant after polylysine treatment. The polycation prevented the release of proteins and phospholipids which passed into the suspending medium from the control cells. Since antisera against Ehrlich ascites cells caused a similar change in leakage and morphology of the tumor cells as did the polylysine, it is suggested that antibody-complement and polylysine affect similar sites.

Microfilm \$2.75; Xerox \$5.20. 105 pages.

NITRATE REDUCTION IN SOILS

(Order No. Mic 61-2264)

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Supervisor: Dr. John T. Pesek, Jr.

The reduction of nitrate- to ammonium-N, involving the substitution of nitrate for oxygen as a hydrogen acceptor, is a well demonstrated microbial process. However, several recent denitrification studies in soils in which tracer nitrogen was used indicated that reduction of nitrate- to ammonium-N occurred, but, compared to denitrification, was relatively unimportant. The objectives of the study in this research were: to investigate the importance of reduction of nitrate- to ammonium-N under water-logged conditions in a range of soils and, in the event of soils being found in which ammonium formation from nitrate was appreciable, to investigate the mechanism of its formation. The latter phase of the work included studies of possible reduction of nitrate- to ammonium-N by ferrous hydroxide during the distillation procedures of the chemical analyses.

Eight soils which varied in chemical and physical composition and geographical origin were used in the investigations. Studies were first made of nitrate-, nitrite- and ammonium-N changes in 5 g. samples of these soils on incubation for different lengths of time under water-logged conditions in the presence and absence of added nitrate. Labelled nitrate-N was used to determine the relative importance of denitrification and nitrate respiration in the soils studied.

On incubation under water-logged conditions of two moderately acid soils (Cecil sandy loam and a Kalkaska sand) considerably more ammonium-N was produced when the soils had been pre-treated with potassium nitrate. The increases in soil ammonium over that found in the control-treated soils were found to be the result of chemical rather than biological reduction of nitrate. During grinding small amounts of steel contaminated the two soils, and activated hydrogen produced on the surfaces of the steel particles under the water-logged conditions in these moderately acid soils was able to reduce the nitrate- to ammonium-N. On incubation of the six Iowa soils under water-logged conditions the ammonium accumulations were less in the nitrate-treated soils. The hypothesis is advanced that in these nitrate treated water-logged soils larger portions of the ammonium produced through ammonification are nitrified in the oxygenated water layers adjacent to the air.

By the use of labelled nitrate-N, denitrification was shown to occur readily in the six Iowa soils without the addition of an external source of oxidizable carbon, but nitrate reduction to ammonium was of little importance in any of the soils. A maximum of 1.6% of the applied nitrate-N was reduced to ammonium-N. No evidence was found to indicate that nitrate was reduced chemically to ammonium by ferrous hydroxide during the distillation procedures of the analytical methods.

Microfilm \$2.75; Xerox \$4.40. 85 pages.

CHANGES IN THE VOLATILE FLAVOR COMPONENTS OF STERILE CONCENTRATED MILK DURING STORAGE

(Order No. 61-3146)

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Supervisor: Professor Harold E. Calbert

Sterile concentrated milks are given high heat treatments to obtain sterility. To avoid caramelization, it is necessary to use very high sterilization temperature (290-300°F.) with an extremely short holding time (less than 4 seconds). A characteristic flavor, which is perhaps best described as an "old rubber boot flavor," develops in this type of product during storage. This flavor appears to increase rapidly if the product is stored at a temperature higher than room temperature.

Changes in processing treatments were made to study the influence of these on the development of volatile flavor components in sterile concentrated milk. Variations in the temperature and duration of storage were made to study their effects on the flavor changes. Low-tempera-

ture, reduced-pressure vacuum distillations were used to isolate the volatile flavor compounds from the product. Paper and gas chromatography were used to identify volatile flavor components.

1. Paper chromatography indicated the presence of six different compounds in the distillate obtained from sterile concentrated milk. Three of these were tentatively identified as acetone, acetaldehyde and 2-pentanone. It also was observed that there were more than six compounds in the distillate due to the presence of some compounds being left at the starting point, after separation of six compounds on the paper chromatogram.
2. Gas chromatographical work has shown the presence of eight different compounds in the distillate from sterile concentrated milk. Of these eight compounds, four were tentatively identified as acetaldehyde, dimethyl-sulphide, acetone and 2-pentanone, by their retention time and the odor of the compounds at the time of emerging from the gas chromatography equipment.
3. The mass spectrum of a fraction collected from a major peak has given the indication that the unknown compound may be some type of ester having a molecular weight of 130.
4. When subjected to an evaluation by a trained taste panel, 2-heptanone, dimethyl sulphide, 1-ethyl propyl acetate, 2, 2-dimethyl propyl acetate, 2-methyl butyl acetate, 1, 2-dimethyl propyl acetate, tertiary amyl acetate and 2-methyl butyl acetate could be tentatively detected at levels as low as 0.125 p.p.m. in whole milk. While acetone was detected at 3 to 5 p.p.m., acetaldehyde at less than 0.5 p.p.m., and 2-pentanone at less than 0.75 p.p.m.
5. The presence of different numbers of peaks, varying in size, in the chromatograms of the distillates obtained from sterile concentrated milks freshly prepared by different processing treatments, indicated these treatments had some influence on the volatile flavor components of the products.
6. The chromatograms obtained from the distillate of the products of each of the treatments, stored at different temperatures for different periods of time, have shown variations in the number of peaks obtained as well as variations in the area under each individual peak.

The maximum number of the peaks appearing in the chromatogram of freshly prepared products was 4 or 5. The number of peaks was increased to 7 or 8 in the chromatogram obtained from the storage products, depending upon the temperature and duration of storage. Practically all of the peaks were found in the chromatogram obtained from the products stored at 35°F. for four weeks. This lead to the belief that some changes in the volatile flavor components of the products occurred during the storage periods. Microfilm \$2.75; Xerox \$4.60. 89 pages.

THE METABOLISM OF LYSOPHOSPHATIDIC ACID

(Order No. 61-3148)

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Supervisor: Associate Professor Lowell E. Hokin

Earlier studies had demonstrated the biosynthesis of phosphatidic acid from diglyceride and ATP³² in the presence of a deoxycholate solubilized enzyme from guinea pig brain. Incubation of monoglyceride with ATP³² under similar conditions produced a new, unknown radioactive phosphatide in addition to phosphatidic acid. The characterization and the metabolism of this new phosphatide have formed the subject of this dissertation.

Co-chromatography of the radioactive phosphatide with carrier lysophosphatidic acid in three different paper chromatography systems revealed that the radioactive compound and the carrier lysophosphatidic acid had identical R_f values in all three cases. When the radioactive phosphatide and phosphatidic acid, produced in the same incubation, were subjected to mild alkaline hydrolysis followed by paper chromatography in a system that separated α - and β -glycerophosphate, both compounds yielded only α -glycerophosphate as the radioactive hydrolysis product. This evidence indicated that the radioactive compound was an α -lysophosphatidic acid.

The biosynthesis of the lysophosphatidic acid was dependent only on ATP and α - or β -monoglyceride; neither diglyceride, glycerol, nor α -glycerophosphate was implicated in the reaction. Unsaturated monoglycerides were more effective substrates than were saturated monoglycerides. The presence of added fatty acid was found in some experiments to stimulate the formation of lysophosphatidic acid. *p*-Chlorophenylmercurisulfonate inhibited the reaction at low concentrations.

The enzyme, which has been termed monoglyceride kinase, was isolated from deoxycholate extracts of either the cytoplasmic particulate or microsomal fractions of guinea pig or calf brain. Treatment of the solubilized enzyme with 30 per cent saturated ammonium sulfate enhanced the specific activity of the enzyme and greatly increased the ratio of lysophosphatidic acid to phosphatidic acid formed.

The observed stimulation of the biosynthesis of phosphatidic acid as well as lysophosphatidic acid caused by the addition of exogenous monoglyceride indicated that phosphatidic acid might be formed directly from lysophosphatidic acid. This possibility was investigated by incubating a chemically synthesized α ; β -(α' -oleyl)-lysophosphatidic acid labeled with phosphorus-32 with palmityl-coenzyme A and the cytoplasmic particulate fraction (not treated with deoxycholate) of either guinea pig brain or liver. A relatively rapid and extensive conversion to phosphatidic acid occurred. Omission of palmityl-coenzyme A reduced phosphatidic acid formation to one-half in the liver system, and to one-third in the brain system.

Very active phosphatase activity was found in both the liver and brain preparations. Guinea pig liver cytoplasmic particulate fractions also contained demonstrable phosphatidase enzyme(s), which acted on both α - and β -lysophosphatidic acid; however, brain cytoplasmic particulate fractions appeared to contain a phosphatidase that deacyl-

ated only α -lysophosphatidic acid. The enzyme activities were measured by counting the radioactivity of inorganic phosphate, α -, and β -glycerophosphate which were isolated from the incubation mixture and were separated by paper chromatography.

Exogenous sodium fluoride increased the quantity of recoverable phosphatidic acid, α -, and β -glycerophosphate by greatly inhibiting phosphatase activity. Magnesium sulfate had very little measurable effect on the enzymatic acylation or degradation of lysophosphatidic acid. Ageing the enzyme at -20°C for 8 days greatly decreased all enzyme activity except that of the phosphatases.

It was concluded from the above observations that phosphatidic acid could be biosynthesized from monoglyceride via the intermediary metabolite, lysophosphatidic acid as follows: monoglyceride \rightarrow lysophosphatidic acid \rightarrow phosphatidic acid. Lysophosphatidic acid was also readily degraded to inorganic phosphate, glycerophosphate, and fatty acid by enzymes present in both guinea pig brain and liver. Microfilm \$2.75; Xerox \$5.40. 109 pages.

STUDIES ON A NEW SERIES OF METABOLICALLY ACTIVE PHOSPHOLIPIDES

(Order No. 61-3160)

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Supervisor: Associate Professor Lowell E. Hokin

It was previously shown in this laboratory that radioactive orthophosphate was incorporated into some unidentified phospholipides when brain cytoplasmic fractions were incubated under conditions of oxidative phosphorylation. These compounds could be separated into discrete radioactive spots, named A, B, and C, by chromatography on silicic acid impregnated paper with phenol-ammonia as the solvent.

The present work was aimed at a study of some of the metabolic properties of these compounds, and their isolation, purification, and characterization.

Metabolic experiments have shown that the incorporation of P³² into these phospholipides occurs in purified mitochondria. Fluoride did not affect the incorporation of P³² into these phospholipides in mitochondria undergoing oxidative phosphorylation; on the other hand, fluoride greatly enhanced the incorporation of P³² into the known phospholipides.

Phospholipide A has been purified by means of silicic acid column chromatography and countercurrent distribution. A striking property of the acidic form of phospholipide A is its exclusive affinity for the non-polar phase in all the solvent pair systems tested. The remaining phospholipides, on the other hand, partitioned to a lesser or greater degree between both phases.

Preliminary work on the characterization of phospholipide A has shown that a series of saturated and unsaturated fatty acids with a chain length of C-10 to C-22 form part of its molecule.

The water soluble skeleton of phospholipide A, obtained by mild alkaline hydrolysis, was purified by means of ion exchange chromatography. Its position in the chromatogram

indicated that its net negative charge was much larger than that of the water soluble hydrolytic products of the other phospholipides. The water soluble skeleton of phospholipide A exhibited an ultraviolet spectrum with two absorption maxima (280 m μ and 250 m μ). Acid hydrolysis with 1 N HCl cleaved this compound into a number of fragments which were separated by ion exchange chromatography. Ammonia and a number of amino acids were also obtained on hydrolysis with 6 N HCl for 18 hours at 110° C.

Further preliminary characterization of phospholipide A was carried out by means of periodate oxidation. As a working hypothesis a partial structure of the molecule has been proposed, in which the possibility of two glycerols and one inositol per four atoms of phosphorus is considered. Microfilm \$2.75; Xerox \$7.00. 147 pages.

CERTAIN CAROTENOIDS OF ZEAXANTHIN (YELLOW CORN)

(Order No. 61-3019)

Dinesh Chandra Sharma, Ph.D.
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Carotenoid pigments of yellow corn were extracted with hexane-alcohol mixture, saponified with alcoholic potassium hydroxide at room temperature, and separated chromatographically on a magnesia-supercel column. Adsorption characteristics, response to elution, visible and ultraviolet absorption spectra, infrared absorption spectra, optical activity, chemical reactions and biological assays for provitamin A activity were the procedures used to identify the pigments isolated.

In addition to α -carotene, β -carotene, cryptoxanthin, lutein and zeaxanthin, presence of zeta-carotene in corn has been demonstrated. Another pigment, tentatively called eta-carotene, having absorption maxima at 400 and 425 m μ (in hexane) but distinct from zeta-carotene in having an additional maximum at 451 m μ and markedly different absorbance ratios of the main peaks, was detected. Eta-carotene appears between β -carotene and zeta-carotene on a magnesia-supercel column; prior removal of accompanying colorless waxy impurity appears necessary for a distinct separation of zeta-carotene and eta-carotene zones. Neither zeta-carotene nor eta-carotene had provitamin A activity for chicks. Earlier reports on the occurrence of zeta-carotene in yellow corn are confusing because the absorption spectra reported for such carotenoid fractions are markedly different from the absorption spectrum of zeta-carotene from other sources.

A carotenol occurring to an extent of about 15 per cent of total pigments was also isolated chromatographically. It adsorbed between cryptoxanthin and zeta-carotene on a magnesia-supercel column. The carotenol was optically active and had absorption maxima at 420, 445.5 and 475 m μ in hexane solution. The absorption spectra in chloroform, carbon disulfide and hexane resembled those of α -carotene and lutein, and it had no biological activity as a provitamin A, even when administered at an 80 mmg/chick/day level to White Leghorn chicks. The infrared absorption spectrum indicated a free hydroxyl group in the molecule, and in accordance to the physical, chemical and biological properties of the carotenol, it is probably 3-hydroxy- α -carotene.

Cryptoxanthin, β -carotene and α -carotene were administered in cottonseed oil at various levels to obtain additional information on their relative provitamin A activity for White Leghorn chicks, and to find a suitable daily dose for good growth. Cryptoxanthin was slightly more than 25 per cent as active as an equivalent dose of vitamin A on weight basis; β -carotene had about 50 per cent of the activity of vitamin A and α -carotene had about half the provitamin A activity of β -carotene. Chicks given a 20 mmg daily dose of cryptoxanthin or 10 mmg daily dose of β -carotene grew better than those given lower levels of these provitamins A, suggesting that lower levels were inadequate for White Leghorn chicks. Zeaxanthin and lutein were confirmed to be inactive as provitamins A for chicks. Microfilm \$2.75; Xerox \$8.40. 183 pages.

I. VISCOSITY AND ELECTRON MICROSCOPE STUDIES OF PROTEINS AND SYNTHETIC POLYPEPTIDES.

II. AN ELECTRON MICROSCOPE STUDY OF THE EFFECT OF POLYLYSINE ON ESCHERICHIA COLI.

(Order No. 61-3165)

Donald Edward Slagel, Ph.D.
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Supervisor: Professor Mark A. Stahmann

Intrinsic viscosity determinations were made on bovine albumins modified by reaction with N-carboxy anhydrides of glutamic acid, leucine, phenylalanine, and glycine, to ascertain the effect of charged and neutral amino acids upon the hydrodynamic volume of the polypeptyl protein.

Intrinsic viscosity measurements of polyglutamyl albumins with differing amounts of glutamic acid were carried out at two pH levels, one at which most of the γ carboxyl groups of the glutamyl peptides were protonated and the other at which they were ionized. Ionization caused an increase in viscosity of the modified protein. Intrinsic viscosities were also determined for polyphenylalanyl, polyleucyl, and polyglycyl bovine albumin. A polyphenyl and a polyleucyl albumin had a greater molal volume than did a polyglutamyl albumin with a comparable degree of modification. This suggested that the nonpolar polyphenylalanyl polypeptides may have increased the icelike hydration sheath about the modified protein.

Intrinsic viscosity determinations on dichloroacetic acid and aqueous sodium chloride solutions of a series of poly- γ -benzyl-L-glutamates, and poly-L-glutamic acids allowed estimation of the extent of peptide bond hydrolysis, and subsequent lowering of the molecular weight under conditions used to cleave the blocking benzyl groups from the synthetic poly-L-glutamates. Viscosity average molecular weights determined for the poly- γ -benzyl-L-glutamates were 30,700, 63,000, and 312,000 and for the corresponding poly-L-glutamates 5,800, 9,800, and 15,000 respectively. From these figures the degree of polymer backbone breakage was calculated to be 3, 4, and 12 for the 30,700, 63,500, and 312,000 molecular weight compounds.

An electron microscope study of synthetic polypeptide and proteins was carried out to provide information on the

size, shape and molecular weight distribution. Four techniques were used: uranium shadowing on collodion covered electron microscope grids, uranium shadowing of organic soluble molecules on carboned collodion grids, freeze drying of organic soluble molecules and platinum replication of molecules. The best results were obtained with the platinum replication, a modification of the one developed by C. E. Hall. Particles having molecular dimensions were observed in preparation of block copoly-L-leucyl-L-glutamate and random copoly-L-leucyl-L-glutamate. The molecular weight distributions were calculated for the block copoly-L-leucyl-L-glutamate. This technique was also applied to polyglutamyl bovine plasma albumin which appeared as a large aggregate of particles each having an approximate diameter of 60 Å. and to the six heme particle of cytochrome C₁ which appeared as short rods having an approximate length of 350 Å.

An electron microscope study was carried out to gain additional information on the nature of the bacteriostatic effect of poly-L-lysine on *Escherichia coli*. In the initial experiment *E. coli* was incubated overnight in a tryptone broth. One portion of the culture was treated with poly-L-lysine at a concentration of 1 mgm/10 ml of culture and another was kept as a control. These were fixed in a buffered 1% osmium tetroxide solution. The bacterial cells were suspended in agar, dehydrated and embedded in the epoxy resin, Araldite. Thin sections were cut and observed in the electron microscope. The electron micrographs of the untreated cells showed a cell wall, cytoplasmic membrane, an osmophilic cytoplasm which contains ribonucleoprotein particles that range in size from 100 to 200 Å. in diameter and a nuclear vacuole along the longitudinal axis of the cell. The most prominent morphological difference in the cells treated with polylysine was the appearance of a marginal vacuole inside the cytoplasmic membrane. The cell agglutination caused by the polylysine treatment was clearly demonstrated in the electron micrographs which showed the cell walls of adjacent cells closely immeshed. The effect of the growth phase on bacterial morphology was also illustrated by electron microscopy. A logarithmic growth curve of *E. coli* cells growing in an inorganic salt media was obtained by optical density measurements. The exponentially growing cells and the polylysine treated exponentially growing cells had a similar morphology to the control and polylysine treated cells described previously. However the morphology of the untreated cells in the senescent phase of growth was very much like the polylysine treated cells with a well defined marginal vacuole. This morphological resemblance was so strong that it suggested that polylysine created a condition similar to the senescent phase.

A quantitative determination of amino acid released by polylysine treatment of *E. coli* was carried out with the Spinco Amino Acid Analyzer. Increases of more than 60% were observed in: unknown 2 (320%), aspartic acid (80%), glutamic acid (60%), valine (200%), unknown 6 (60%) and leucine (120%). We concluded that polylysine increased the transport of amino acids out through the bacterial cell wall. Microfilm \$2.75; Xerox \$8.00. 172 pages.

BEHAVIOR OF TRYPSIN IN ORGANIC SOLVENTS

(Order No. Mic 61-1587)

Spyros M. Vratsanos, Ph.D.
Fordham University, 1961

Mentor: F. F. Nord, Ph.D.

Life on the earth has been greatly dependent on water as an environment. Thus, investigations of proteins in aqueous media are, in principle, natural approaches to problems concerning these intricate macromolecules.

Nevertheless, application of organic solvents to protein chemistry can be always of interest, at least from an organic or physical chemist's point of view.

In these studies, formamide, dimethyl sulfoxide and their mixtures with aqueous media were used as solvents of trypsin. The enzyme may undergo the influence of the organic environments and retain virtually all its activity, if no alkalinity is present either in the organic solution or in an aqueous medium used as a diluent of it. The dilution was accepted as a means to transfer trypsin from the organic to a practically completely aqueous environment, under which condition the retention of enzymic activity was examined.

Alkalinity may be harmful also whenever trypsin is exposed to mixtures of formamide or dimethyl sulfoxide with aqueous media. The greatest sensitivity of trypsin is exhibited towards organic solvent - water mixtures of equimolar compositions. Deviations from this condition in either direction increase the chances for survival of trypsin.

Any loss of tryptic activity occurring upon the use of the organic solvents or their mixtures with aqueous media are irreversible.

The temperature effect (region, 3 - 60°C.) on trypsin in formamide is unusual; the best chances for retention of activity are at about 40°C. and not in the cold.

There is evidence that trypsin undergoes unfolding in the organic solvents. The best evidence comes from the increased accessibility of the free amino groups of the enzyme during acetylation in the organic solvents. The comparison is made on the basis of the availability of free amino groups during acetylations in the usual aqueous acetate buffer.

In acetylations carried out in aqueous media active and inactive acetyltrypsins may be formed. The appearance of these two acyl forms is associated with the substitution of the free amino groups of trypsin; the inactive form is characterized by a heavier than 50% amino group substitution.

However, acetylations of trypsin in dimethyl sulfoxide give rise to a gradual loss of activity upon the progressive introduction of acetyl groups. Complete inactivation occurs with the introduction of about 15 acetyl groups per trypsin molecule. Comparison of the data of radioactivity (acetic-1-C¹⁴ anhydride) with the results of the ninhydrin reaction for free amino group content of trypsin shows that the acetylation is highly specific for the amino groups of trypsin. This was established also from the fact that aliphatic amines present during the acetylation of trypsin in dimethyl sulfoxide compete successfully with trypsin in the utilization of acetic anhydride. On the contrary, aromatic amines, phenols and aliphatic alcohols fail to be

acetylated in the presence of trypsin, in dimethyl sulfoxide. One more evidence about the specific reactivity of the free amino groups of trypsin is obtained by observing the yield of the acetylation; the yield is high until about 16-17 acetyl groups are introduced, and then declines sharply. The result is meaningful given that the most probable value for the amino group content of trypsin is about 16-17 groups per molecule.

It appears therefore that under the conditions employed the amino group(s) is (are) essential for the activity of the enzyme. This finding is compatible with the fate of trypsin upon acetylation in aqueous media. The key to a unified understanding of the behavior of trypsin in aqueous or non-aqueous acylations may be the different distributions of configurations of the enzyme in the various environments. According to the results, it stands to reason that disordered configurations, which are rather improbable in an aqueous solution, are more probable in the organic medium.

Attempted acetylations of trypsin in formamide resulted in an extensive formylation accompanied by minor acetylation.

The use of phthalic, palmitic and bicyclo(2,2,1) 5-heptene 2,3, dicarboxylic anhydrides as acylating agents of trypsin in dimethyl sulfoxide, resulted in a very early (with respect to acetylation) inactivation of the enzyme. These types of acyltrypsin displayed markedly different residual activities against hemoglobin and benzoylarginine ethyl ester. Generally, the patterns of inactivation of trypsin having bulky substituents cannot be easily analyzed as being the result of superposition of various effects.

Microfilm \$2.75; Xerox \$6.80. 142 pages.

THE EFFECT OF PENICILLIN ON CELL WALL SYNTHESIS IN *ESCHERICHIA COLI*

(Order No. 61-3102)

Edward Bernard Wylie, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Marvin J. Johnson

The effect of penicillin on the cell wall of *E. coli* has been studied.

Growing cultures began to lyse 45 minutes after addition of 15 μ g penicillin per ml, or in 30 minutes with 30 μ g per ml. Lysis was prevented and spheroplasts were formed if 10% sucrose was added.

The amount of acid-soluble labile phosphate in cells and the total amount of amino sugar in cultures were determined. Cells grown for 30 minutes in 10 to 30 μ g penicillin per ml increased in dry weight, labile phosphate and amino sugar to the same extent as normal cells. This indicated that penicillin does not cause accumulation of cell wall precursors containing labile phosphate or amino sugars.

Cell wall synthesis was measured by growing cells in medium with radioactive label and determining the activity incorporated into isolated cell walls. Wall synthesis by cells grown for 30 minutes in 15 μ g penicillin per ml and by spheroplasts grown for 1 hour in 30 μ g per ml was equal to the synthesis by normal cells.

Normal and penicillin-grown walls had the same nitrogen, phosphorus, lipid and reducing sugar content. Walls from cells grown for 30 minutes in 30 μ g penicillin per ml had 32% less amino sugar than normal walls.

The individual amino components of cell walls were quantitatively determined. Penicillin-grown walls had less glucosamine, muramic acid and diaminopimelic acid than normal walls. The amounts present were about 60% of normal after 30 minute growth in 15 μ g penicillin per ml, and about 40% of normal after 2 hour growth of spheroplasts in 30 μ g penicillin per ml.

Although the normal incorporation of label from growth medium into total cell wall substance was not affected by penicillin, incorporation of label into cell wall muramic acid and glucosamine was inhibited by penicillin. The amounts of inhibition during growth in 15 μ g per ml penicillin were 27% and 59% for glucosamine and muramic acid, respectively, after 30 minutes of growth, and 6% and 19% after 15 minutes.

Penicillin prevents the incorporation of the minor components glucosamine, muramic acid and diaminopimelic acid into the cell wall structure of *E. coli*. The major part of wall synthesis is not affected by penicillin, but the abnormal structure formed lacks the mechanical strength of the normal wall.

Microfilm \$2.75; Xerox \$3.60. 65 pages.

VOLATILE FLAVORING CONSTITUENTS OF BEEF AND OYSTERS AND ORGANOBORON COMPOUNDS OF ALFALFA

(Order No. 61-2991)

Mao Hsun Yueh, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor F. M. Strong

The volatile fraction from lean beef cooked in boiling water was shown to contain hydrogen sulfide, ammonia, acetaldehyde, acetone, and diacetyl. In addition the presence of formic, acetic, propionic, butyric and isobutyric acids, and of dimethyl sulfide was tentatively established. Volatile alcohols and esters were absent. The amount of hydrogen sulfide obtained after 3 hours boiling was 6 - 8 mg. per kg. of beef, but much larger amounts were evolved after boiling for seven days.

The chief volatile flavoring substance from both fresh and cooked oysters has been found to be dimethyl sulfide. Very much smaller amounts of hydrogen sulfide, methanethiol, ammonia, diacetyl (or acetylmethyl carbinol), and of several simple volatile carbonyl compounds were also detected.

Alfalfa leaf meal was processed in an attempt to isolate its boron-containing substances. Among the fractions isolated one was found to contain 1,400 ppm. of boron, approximately a 37 fold increase in boron content as compared to the original in alfalfa leaf meal. The fraction contained no phosphorus and had a boron to sugar ratio of approximately 1:100.

Evidence was obtained that some of the boron-containing substances in alfalfa leaf meal exist in organic forms. However, the exact nature of such compounds has not been established. Microfilm \$2.75; Xerox \$5.00. 97 pages.

CHEMISTRY, INORGANIC

GERMANIUM AND SILICON PHTHALOCYANINES

(Order No. 61-3317)

Ralph Delmer Joyner, Ph.D.
Case Institute of Technology, 1961

New germanium and silicon phthalocyanines are described which represent a unique approach to the metal phthalocyanines. All of the molecular changes in these compounds are brought about through the use of the metal functionality of the phthalocyanines. The solubility and volatility of silicon and germanium phthalocyanines are varied by changing the groups inorganically bonded to the phthalocyanine. The compounds discussed make use of the hexacoordination possessed by germanium and silicon. This hexacoordination is unusual, since germanium, and particularly silicon, rarely form hexacoordinated structures except in complex ions. Because of the rigid planar structure of the phthalocyanine unit, this hexacoordinated arrangement is probably octahedral. An S_N1 substitution mechanism is indicated for the hydrolysis of Ge-Cl and Si-Cl bonds in this atomic configuration. Unusual stereochemistry is further demonstrated in the preparation of siloxanes which contain both six-coordinated and four-coordinated silicon. The preparation and characterization of a linear polyphthalocyanylsiloxane is described. This is apparently the first time a hexacoordinated silicon atom has been employed in the repetitive unit of a silicone. The phthalocyanine units of the polyphthalocyanylsiloxane are probably touching each other, and the Si-O-Si bond angle is probably 180° .

Microfilm \$2.75; Xerox \$4.00. 72 pages.

ALUMINUM PHTHALOCYANINES

(Order No. 61-3309)

James Emmet Owen, Ph.D.
Case Institute of Technology, 1961

New aluminum phthalocyanines were prepared and characterized in which various organic and organometallic groups were attached to the aluminum. The wavelengths at which absorptions occurred in the visible spectra of these compounds were constant. It was thus concluded that the group attached to the aluminum had no effect on the electronic transitions corresponding to these absorptions.

The thermal decomposition of hydrated hydroxyaluminum phthalocyanine was studied. The decomposition was found to be stepwise. Some of the stable decomposition products were identified. Phthalocyanine aluminum oxide, the end product, was isolated and characterized. It was concluded that this compound probably had two phthalocyanine rings (almost touching each other) joined by means of oxygen bridges between the central metal atoms and that the resulting Al-O-Al bond was probably close to 180° . Similar compounds, bis-(phthalocyanylaluminum) phthalocyanylsiloxane and bis-(phthalocyanylaluminum)diphthalocyanylsiloxane with three and four phthalocyanine rings joined by oxygen bridges between the central metal atoms were prepared and identified. Again it was concluded that

the inorganic backbones of these compounds, Al-O-Si-O-Al and Al-O-Si-O-Si-O-Al, were probably linear. The aluminum phthalocyanyl portion of these molecules was removed without disrupting the central silicon phthalocyanine portion. This was significant because it yielded a unique method for the controlled condensation of dihydroxysilicon phthalocyanine.

Microfilm \$2.75; Xerox \$5.60. 114 pages.

PHYSICAL PROPERTIES OF
NIOBIUM IODIDES

(Order No. 61-3049)

Pyrtle William Seabaugh, Jr., Ph.D.
Iowa State University of Science and Technology, 1961

Supervisor: John D. Corbett

Lower oxidation states in the solid niobium iodides have been prepared and characterized. Thermal and differential thermal analysis, equilibrations and X-ray powder diffraction data were utilized for the construction of the phase diagram for the niobium-iodide system. The heretofore unknown $NbI_{2.67}$ has been prepared and preliminary dissociation pressures for the NbI_5 - NbI_4 system have been recorded. A summary of the iodides with some of their properties is found in Table 1.

Table 1. Niobium iodides

I Nb	Temperature of heat effect	Process
5.00	400°	melting
4.00	503°	incongruent melting
	417°	phase transformation(β - γ)
	348°	phase transformation(α - β)
3.00	526°	disproportionation
2.67	(>790°)	(melting)

Three polymorphic forms of niobium tetraiodide were found. Powder patterns show distinct γ and α temperature forms; however, they do not distinguish between the β and α temperature forms. Iodine dissociation pressures indicate that this transformation is sluggish.

In contrast to niobium trichloride, which has a wide range of variable composition, the triiodide is a simple stoichiometric compound which can be sublimed. Unlike the niobium chloride and bromide, niobium diiodide apparently does not exist as a solid equilibrium phase and the solid iodide in equilibrium with the metal is $NbI_{2.67}$. Qualitative magnetic measurements indicate that all the niobium iodides are diamagnetic. This diamagnetism of the lower iodides may be attributable to metal-metal bonding which is known to exist in the low temperature form of the tetraiodide.

The decomposition pressure results for the NbI_5 - NbI_4 are also discussed and some tentative interpretation of the behavior are given. X-ray powder pattern data for all the iodides of niobium are reported.

Microfilm \$2.75; Xerox \$3.60. 63 pages.

HETEROPOLY MOLYBDATE ANIONS
OF CERTAIN FIFTH GROUP
AND TRANSITION ELEMENTS:
PARTIAL ELUCIDATION OF STRUCTURES
AND CHEMICAL PROPERTIES.

(Order No. Mic 61-1104)

George Andrew Tsigdinos, Ph.D.
Boston University Graduate School, 1961

Major Professor: Louis C. W. Baker

The contributions of this work may be summarized under six main headings:

I. Exchanges of Radioactive Isotopes:

The first isotopic exchange studies involving heteropoly anions with transition metal central atoms are reported.

1) The exchanges of Mo^{99} between paramolybdate anion, $[\text{Mo}_7\text{O}_{24}]^{-6}$, and (a) 6-molybdochromate(III) anion, $[\text{CrO}_6\text{Mo}_6\text{O}_{15+n}\text{H}_{2n}]^{-3}$, and (b) its isomorph, 6-molybdo-ferrate(III) anion, $[\text{FeO}_6\text{Mo}_6\text{O}_{15+n}\text{H}_{2n}]^{-3}$, were studied over the pH range 2.5-4.5 at 29.5°C. and at 0°C. At the higher temperature, all the Mo exchanges were complete in less than 0.5 min. At 0°C. the half-time for the Mo^{99} exchange with the chromic complex was 35 min. at pH 2.5, while the exchange of Mo^{99} with the ferric complex was 80% complete in less than 1 min. at the same conditions. The exchange rate increased with increasing pH.

These results are discussed in terms of the mechanisms of inorganic substitution reactions and the structures of the anions involved. The difference in exchange rates for the Cr and Fe complexes is explained primarily in terms of the inflexibility and compactness which crystal field stabilization energy imparts to the CrO_6 central octahedron in contrast to the spin-free d^5 FeO_6 octahedron. The exchange process is seen as most probably involving dissociation of MoO_x polyhedra away, probably as MoO_4^- groups, from both paramolybdate and the heteropoly species. In view of structural limitations, such dissociations of the polyanions would almost certainly have to follow displacement attack by at least two solvent molecules on the MoO_6 octahedra of the complex. This strengthens indications that d^0 octahedral complexes undergo substitutions via displacement reactions.

2) The exchange of Cr^{51} between $[\text{CrO}_6\text{Mo}_6\text{O}_{15+n}\text{H}_{2n}]^{-3}$ and $[\text{Cr}^{51}(\text{H}_2\text{O})_6]^{+3}$ was studied at 29.5°C., total ionic strength = 0.446, and total H^+ concentrations between 0.01 and 0.10. Half-times ranged between 4.3 and 45 minutes. As with the Mo exchanges, excellent separations giving clear-cut reproducible data were devised.

Cr(III) complexes are characteristically very inert. This is the first which has been shown to exchange its Cr(III) rapidly.

Since the half-time for O^{18} exchange between solvent and $[\text{Cr}(\text{H}_2\text{O})_6]^{+3}$ is about 40 hours under similar conditions, but the H-O bonds in that cation are labile, it is proposed that CrO_6 is exchanging as a unit, with unbroken Cr-O bonds. This is the first case where exchange of an MO_x polyhedral unit has been indicated.

The Cr exchange goes more rapidly as the pH is lowered.

Viewing the heteropoly anions as polynuclear complexes and, with respect to each metal atom, as polydentate also,

this special category of complexes is seen as providing the first examples of rapidly exchanging polydentate groups and of polynuclear species which exchange their central atoms very rapidly.

Kinetic data for the Cr exchange were also collected at very nearly constant pH = 1.06. The rate law

$$R = k_1 [\text{CrO}_6\text{Mo}_6\text{O}_{15+n}\text{H}_{2n}]^{-3} + k_2 [\text{Cr}(\text{H}_2\text{O})_6]^{+3} [\text{CrO}_6\text{Mo}_6\text{O}_{15+n}\text{H}_{2n}]^{-3}$$

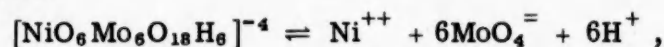
is tentatively advanced because it fits the data fairly well when $k_1 = 1.4 \times 10^{-2} \text{ min.}^{-1}$ and $k_2 = 4 \times 10^{-1} \text{ liter mole}^{-1} \text{ min.}^{-1}$. The first order term may indicate a dissociation process while the second order term might indicate a simultaneous ion-pair path.

II. 6-Molybdonickelates(II) and 6-Molybdorhodates(III):

The older literature leaves heteropoly molybdonickelates(II) and molybdorhodates(III) in a confused state.

The only heteropoly molybdonickelate(II) complex obtained in the present work, despite varied conditions, was blue. Its formula is established as $[\text{NiO}_6\text{Mo}_6\text{O}_{18}\text{H}_6]^{-4}$ by a combination of analyses, measurements of spectra which, via Ligand Field interpretation, reveal a central NiO_6 grouping, potentiometric titrations, dehydration experiments, fused hydrate cryoscopy, and isomorphism with the corresponding tungstate. It has the Anderson-Evans structure, with the hydrogen atoms probably attached to the oxygen atoms of the NiO_6 octahedron.

The Ni(II) complex is monomeric in solution and solid, reversibly decomposes in solution above 60°C., and its free acid decomposes fairly rapidly at room temperature. The instability constant for the anion, according to the reaction:



was found to lie between 10^{-30} and 10^{-33} with the best value 10^{-31} at 32°C. in an aqueous solution saturated with Na_2SO_4 . This was determined by cryoscopy in fused Glauber's salt. It is the first instability constant evaluated for any heteropoly complex. It is also the first instability constant evaluated for any complex by this fused hydrate method. The tungstate isomorph is very much more stable.

Oxidation of the 6-molybdonickelate(II) with persulfate proceeds only at temperatures where the complex has dissociated. The only product resulting is $[\text{Ni}^{+4}\text{O}_6\text{Mo}_6\text{O}_{26}]^{-6}$, whereas the tungstate isomorph gets oxidized only to 6-tungstonickelate(IV).

By similar experimental attack, the 6-molybdorhodate-(III) anion was shown to have the formula $[\text{RhO}_6\text{Mo}_6\text{O}_{15+n}\text{H}_{2n}]^{-3}$. The pure new free acid was prepared and its three dissociation constants lie in the range 10^{-2} to 1.6×10^{-3} .

III. Cryoscopic Determination of Ionic Weights in Solution:

Ionic weights in solution have been determined by cryoscopy in fused $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ for the 6-molybdates of Cr(III) , Fe(III) , Al(III) , Co(III) and Ni(II) . These ions were shown to be monomeric and all except the last were very stable in the sense of magnitudes of stability constants.

Similarly the 5-molybdocobaltate(III) anion was shown to be a very stable dimer.

IV. The Chemistry of Molybdocobaltates:

Since tungstocobaltates form a very interesting group of six interrelated complexes, it was desirable to clarify the molybdocobaltates. No correlation between the two systems emerged. All the molybdocobaltates found are based on CoO_6 octahedra.

Different products were obtained from reactions carried out in the presence or absence of active charcoal (or Raney nickel). Only H_2O_2 was effective at oxidizing Co(II) to Co(III) in the presence of a surface active catalyst, although the products contain no peroxy groups. Other oxidizing agents were effective only in the absence of the catalyst. A quantitative preparation for dimeric 5-molybdocobaltate(III), $[(\text{CoO}_6)_2\text{Mo}_{10}\text{O}_{24}]^{-6}$, in the presence of the catalyst, was found. The catalyst speedily decomposes 6-molybdocobaltate(III). These are the first studies of systems involving only polyanion complexes in the presence of surface active catalysts.

The formula of the dimeric 5-molybdocobaltate(III) anion, $[(\text{CoO}_6)_2\text{Mo}_{10}\text{O}_{24}]^{-6}$, was established by a combination of analyses, demonstration of diamagnetism, interpretation of absorption spectrum, potentiometric titrations, cryoscopy, and dehydration studies which show that this complex may be completely dehydrated easily, without decomposition. The complex decomposes moderately rapidly when the pH is lowered to about 2. A very plausible structure is suggested for it, which reconciles all the evidence. There are apparently very few structural possibilities which do this.

The monomeric 6-molybdocobaltate(III) decomposes into a paramagnetic substance upon dehydration, thus indicating, in agreement with structural principles, that it and its Cr, Fe, Al, Rh, and Ga isomorphs contain constitutional water. Therefore they are formulated $[\text{XO}_6\text{Mo}_6\text{O}_{15+n}\text{H}_{2n}]^{-3}$ wherein "n" is probably 3.

The preparation, described in the earlier literature, of a 9-molybdocobaltate(IV) could not be repeated and it is extremely doubtful if such a complex exists.

V. The Dimeric 9-Molybdates of P(V) and As(V):

These anions have been shown to be isomorphous and of formula: $[(\text{XO}_4)_2\text{Mo}_{18}\text{O}_{54}]^{-6}$. This was established by preparation and potentiometric titration of exceedingly pure samples of salts and free acids. For each acid all six dissociation constants lie within the range 10^{-2} to $10^{-3.5}$. The salts may be dehydrated completely without decomposition.

The As complex is very subject to acid-producing hydrolytic degradation in solution at room temperature, yielding solutions of unchanged appearance but in which the anion is partially degraded. The free acid, for example, had to be made at 0°C . and immediately titrated at not over 15°C . to obtain consistent results.

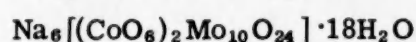
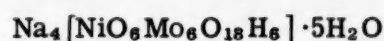
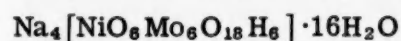
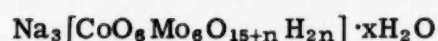
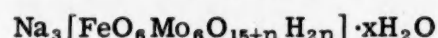
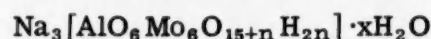
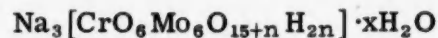
A structural argument shows that the anions are dimeric. The complexes are isomorphous with the anion in the β -form of $\text{K}_6[(\text{PO}_4)_2\text{W}_{12}\text{O}_{54}] \cdot 14\text{H}_2\text{O}$, for which Dawson reported a partial single crystal X-ray structure determination subsequent to the development of the structural conclusions given above. Recent work in this laboratory

on $[\text{CoO}_4\text{W}_{12}\text{O}_{36}]^{-5}$ shows that Dawson's tentative assignment of oxygen positions was correct.

Attempts to prepare heteropoly molybdobismuthates(V) or molybdoantimonates(V) all failed.

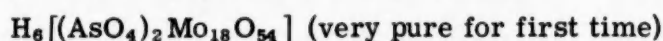
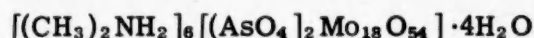
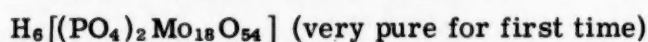
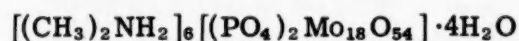
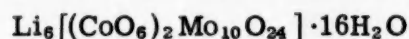
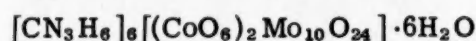
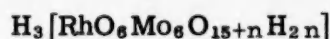
VI. New Compounds:

New compounds analyzed and characterized in this work included:



The foregoing preparations, giving good yields of very pure products, are important because these sodium salts are very soluble. Up to now, study of solution chemistry of these anions was hindered by the unavailability of sufficiently soluble pure salts. These compounds were essential for the exchange experiments and for the cryoscopic determinations.

Other analyzed new compounds include:



Microfilm \$4.90; Xerox \$17.35. 382 pages.

CHEMISTRY, ORGANIC

THE EFFECT OF SOLVENT ON THE DECOMPOSITION OF α -PHENETHYL CHLOROCARBONATES

(Order No. Mic 61-2091)

Elmer Allen Augustin, Ph.D.
University of Washington, 1961

Chairman: Dr. K. B. Wiberg

The decomposition of various substituted α -phenethyl chlorocarbonates have been studied in dioxane, toluene, anisole, chlorobenzene, 1,1,2,2-tetrachloroethane, 4-methyl-2-pentanone, acetophenone, 1-nitropropane,

benzonitrile, and nitrobenzene. The dielectric constants of the solvents employed in this study were measured with the idea of attempting to correlate the rate data with this externally measured property of solvent. The correlation of rate data with dielectric constant failed in the case of the pure solvents; only with the binary mixtures (α -phenethyl chloride in toluene or nitrobenzene) were nearly straight lines obtained when $\log k$ was plotted against $1/D$.

An analysis of the products obtained from the decomposition of α -phenethyl chlorocarbonate in various solvents led to the conclusion that a rearrangement does not occur to give α -phenethyl chloride. The products obtained were hydrogen chloride, carbon dioxide and styrene.

The first order decomposition reaction may be described as an ionization of a neutral molecule which leads to products. Some indication concerning the electrical nature of the transition state was gained from the facts, first, the reaction goes faster in polar solvents than in non-polar solvents; second, the values of ρ , the reaction constant from the Hammett relationship, are large negative numbers; and third, the observation of a primary salt effect.

Microfilm \$2.75; Xerox \$6.20. 129 pages.

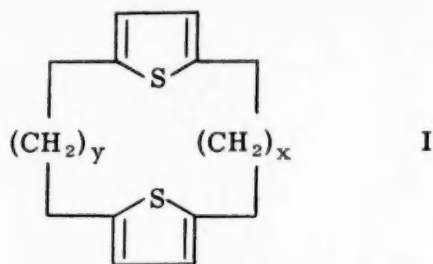
AN INVESTIGATION OF SOME SYNTHETIC APPROACHES TO THE ALPHA-CYCLODIPOLYMETHYLENEDITHIOPENES

(Order No. Mic 61-1944)

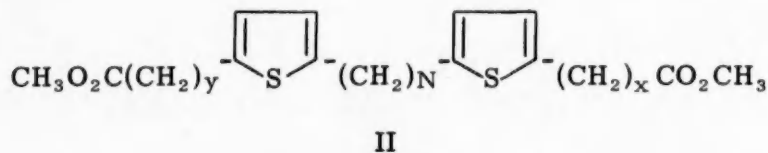
Roger Allan Baldwin, Ph.D.
Michigan State University, 1959

Major Professor: Robert D. Schuetz

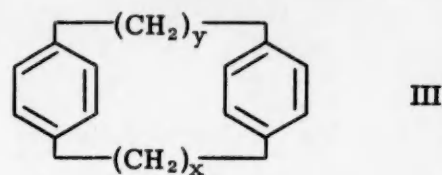
The present study reports an investigation of some synthetic approaches to obtain α -cyclopolymethylenedithiopenes, I.



Methods were developed to obtain esters of type II and



their behavior when such esters were submitted to high dilution intramolecular condensations was investigated. The work reported herein was partially suggested by the rather extensive work of Cram and his collaborators on the synthesis and study of the properties of a number of cyclic molecules involving benzene rings, the paracyclophanes, III.



The latter type of compounds have been shown to possess rather unusual chemical and physical properties (1) due to the modification of the benzenoid resonance as a result of the bending of the two benzene rings into shallow tubs, to transannular effects, and/or to restricted rotation of the benzene rings.

Four, previously unreported, dicarboxylic esters of type II, 1,6-di[2'(5', β -carbomethoxyethyl)thienyl]hexane, 1,6-di[2'(5', γ -carbomethoxypropyl)thienyl]hexane, di[2-(5, γ -carbomethoxypropyl)thienyl]methane, and di[2(5, ω -carbomethoxyamyl)thienyl]methane were prepared from thiophene as the basic starting material using well established general procedures. Under a wide variety of reaction conditions, these esters failed to undergo high dilution acyloin condensations to yield the cyclic acyloins which were the necessary intermediates for obtaining the desired α -cyclopolymethylenedithiopenes. In addition, an intramolecular high dilution Dieckmann condensation of 1,6[2'(5', β -carbomethoxyethyl)thienyl]hexane was unsuccessful. However, ethyl β -(2-thienyl)propionate was successfully converted to the linear acyloin, 3-hydroxy-4-keto-1,6-di(2'-thienyl)hexane establishing that the thiophene ring per se did not prevent the acyloin closure of the diesters.

The methods employed in the synthesis of some twenty intermediate compounds, derivatives of some of these, and finally the dicarboxylic esters are described with recordings of their physical properties.

REFERENCE

1. D. J. Cram, W. J. Wechter, and R. W. Kierstead, J. Am. Chem. Soc., **80**, 3126 (1958), and references therein.

Microfilm \$2.75; Xerox \$5.60. 113 pages.

THE PYROLYSIS OF ESTERS: SYNTHESIS OF 5-METHYLENE-1,3-CYCLOHEXADIENE AND A STUDY OF THE PYROLYSIS OF CYCLOHEXENYL ACETATES.

(Order No. Mic 61-879)

Raymond Anthony Baylouny, Ph.D.
University of Maryland, 1960

Supervisor: Professor William J. Bailey

Since the syntheses of 4,5-dimethylene-1-cyclohexene and 3,6-dimethylene-1-cyclohexene (isomers of *ortho*- and *para*-xylene, respectively) were successfully accomplished by the pyrolysis of esters, the preparation of 5-methylene-1,3-cyclohexadiene, an isomer of toluene, was undertaken. This compound was successfully synthesized by the pyrolysis of 1,4-cyclohexadiene-1-methanol methyl carbonate in methanol (1:3 ratio) at 340°. The product was azeotropically

distilled with methanol at room temperature (25°) and 20-40 mm., with the condensation of the distillate in a Dry Ice-methyl Cellosolve bath. This distillate was mixed with an equal volume of cold (0-5°) water and the resulting solution was extracted with a minimum amount of *n*-pentane. An 87% recovery of the starting ester was obtained by the distillation of the residue from the azeotropic distillation.

When gas phase chromatography was used to separate the components in the *n*-pentane extractions, the desired compound, 5-methylene-1,3-cyclohexadiene, was collected from the elutant gas by means of an appropriate U-tube cooled in a Dry Ice-methyl Cellosolve bath.

Although this compound can be kept indefinitely at Dry Ice temperature, it undergoes rearrangement to toluene moderately rapidly at room temperature.

This isomer of toluene was characterized by an elemental analysis, an appropriate solid derivative with tetracyanoethylene together with a corresponding analysis, an ultraviolet absorption spectrum, an infrared absorption spectrum and a demonstration of its conversion to toluene.

As the earlier results of the pyrolysis of methyl *cis*-2-acetoxy-3-cyclohexene-1-carboxylate were not expected from those of its saturated derivative, methyl *cis*-2-acetoxycyclohexane-1-carboxylate, the pyrolysis of the cyclohexenyl acetate was reinvestigated.

This compound yielded on pyrolysis, three isomeric unsaturated esters, methyl 2,4-cyclohexadienecarboxylate, methyl 1,3-cyclohexadienecarboxylate and methyl 2,5-cyclohexadienecarboxylate.

Each of these esters was characterized by an elemental analysis and an ultraviolet absorption spectrum. A Diels-Alder derivative together with the corresponding analysis was obtained from two of the esters. That these esters are indeed isomeric is supported by their mutual interconversion at 420° with the use of a micropyrolysis tube.

Another ester, diethyl 2-acetoxy-3-cyclohexene-1,1-dicarboxylate, was pyrolyzed to give as the main product, diethyl 2,4-cyclohexadiene-1,1-dicarboxylate, plus isomeric diesters.

Microfilm \$2.75; Xerox \$4.20. 77 pages.

SULFUR ANALOGS OF δ-AMINOLEVULINIC ACID

(Order No. Mic 61-2017)

Mae L. Beck, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. Charles C. Price

Recently, the compound δ-aminolevulinic acid has been assigned a significant role in the metabolism of porphyrins. Several sulfur analogs of δ-aminolevulinic acid were proposed, as the subject of this investigation, for synthesis as possible antimetabolites for use in cancer chemotherapy.

As a result of these investigations several new and interesting reaction sequences with wide application in the field of sulfur chemistry were evolved. These include preparative routes through which a cyclic imide, β-sulfopropionimide, the aliphatic analog of saccharin was pre-

pared and characterized. In addition, β,β'-dithiodipropionic acid and methylene-bis (β thiopropionic acid) were successively treated with thionyl chloride, diazomethane and hydrogen chloride. Treatment of the resulting chloromethyl ketones with potassium phthalimide, however, did not afford the expected incipient amine derivative, but rather an unknown compound devoid of sulfur, perhaps a result of base catalyzed elimination. Another series of transformations successfully carried a chloromethyl sulfide ester through coupling with potassium phthalimide to give a derivative which, upon partial hydrolysis, afforded phthalimidomethyl β-carboxyethyl sulfide and an (o-carboxy)-benzamido derivative. These were successfully oxidized to the sulfone and sulfoxide respectively. Finally, a novel approach to amine formation employing hexamethylene tetramine with a chloromethyl sulfide in ethanol gave rise to dehydrohalogenation rather than coupling. Two products were isolated; one the result of solvolysis, the other, which was not unambiguously identified, appeared to be a carbomethoxythietane.

Microfilm \$2.75; Xerox \$5.40. 108 pages.

THE PREPARATION OF 6-(SUBSTITUTED-AMINO)- PURINES AND 6-(SUBSTITUTED-MERCAPTO)- PURINES AS POTENTIAL ANTI-CANCER AGENTS

(Order No. 61-3579)

Irwin Becker, Ph.D.
Temple University, 1961

In the Historical Section of the dissertation a discussion of the role of purine compounds in the chemotherapy of cancer and a survey of methods of preparation of 6-(substituted-amino)purines and of 6-(substituted-mercapto)purines are presented.

The laboratory research problem involved the synthesis of 6-(substituted-amino)purines and of 6-(substituted-mercapto)purines, as potential anti-neoplastic agents.

Aminolysis of 6-methylmercaptapurine (VIII) with ethanolamine and with diethanolamine afforded, respectively, 6-(2-hydroxyethylamino)purine monohydrate (CIII) and 6-[bis (2-hydroxyethyl)amino]purine (CV). The former product (CIII) also was prepared from 6-chloropurine (XXVIII) and monoethanolamine. We could not convert the monohydroxy compound CIII to 6-(2-chloroethylamino)purine (CIV). Nucleophilic displacement of the chlorine atom of 6-chloropurine (XXVIII) by the appropriate amine afforded 6-(2-methoxyethylamino)purine (CVI), 6-(2-methyl-1-piperidyl)purine (CVII), 6-carboxymethylamino-purine (CVIII), and 6-(2-carboxyethylamino)purine monohydrate (CIX). Compounds CVI and CVII are new.

Attempts to prepare 3-indolylmethylamine (CX), a known product desired for a projected preparation of 6-(3-indolylmethylamino)purine (CXI) from 6-chloropurine (XXVIII), were unsuccessful. An attempt to prepare N-(6-purinyloxy)indole-3-carboxamide (CXXIV) by means of the acylation of adenine (II) with what was assumed to be a crude preparation of 3-indole-acid chloride (CXXIII) (Schotten-Baumann conditions) was unsuccessful. An effort to obtain 6-(3-indolylmethylamino)purine (CXI) from adenine (II), indole-3-carboxaldehyde (CXII), and formic acid (Leuckart reaction) failed.

N-alkylation of succinimide and of p-toluenesulfonamide with gramine (CXIV) afforded, respectively, 3-(N-succinimidomethyl)indole (CXIX) and 3-[N-(p-toluenesulfonamido)methyl]indole (CXX). Compounds CXIX and CXX are new. By the same procedure we failed to prepare 3-acetylaminomethylindole (CXV), 3-benzoylaminomethylindole (CXVI), 3-(3,4,5-trimethoxybenzoylaminomethyl)indole (CXVII), and 3-(N-isatinylmethyl)indole (CXVIII). The attempted alkaline hydrolysis of 3-(N-succinimidomethyl)indole (CXIX) failed to produce 3-indolylmethylamine (CX).

S-alkylation of 6-mercaptopurine (VI) with the appropriate chloro or bromo reagent in aqueous alkaline medium gave 6-(2-hydroxyethylmercapto)purine hemihydrate (CXXV), 6-carboxymethylmercapto (LV), 6-carboxamidomethylmercapto (CXXX), and 6-acetylmercapto (CXXXI). S-alkylation of 6-mercaptopurine (VI) with 1-bromo-3-chloropropane and potassium carbonate in dimethylformamide produced 6-(3-chloro-1-propylmercapto)purine (CXXVII), and nucleophilic displacement of the chlorine atom of 6-chloropurine (XXVIII) by 2-mercaptobenzimidazole under similar reaction conditions afforded 6-(2-benzimidazolylmercapto)purine monohydrate (CXXXII). Compounds CXXVII and CXXXII are new. Esterification of 6-carboxymethylmercapto (LV) with the appropriate alcohol afforded 6-carboxymethylmercapto (CXXVIII) and 6-carbethoxymethylmercapto (CXXIX). Oxidation of 6-mercaptopurine (VI) with iodine in potassium iodide solution produced purinyl-6-disulfide hemihydrate (XCIX).

Cyanoethylation of 6-chloropurine (XXVIII) gave 6-chloro-9-(2-cyanoethyl)purine (CXXXIV), a new compound. Microfilm \$2.75; Xerox \$6.60. 139 pages.

AN INVESTIGATION OF SPECIFIC METAL EFFECTS IN REACTIONS OF METAL-CYCLOPENTADIENYL COMPOUNDS

(Order No. Mic 61-267)

Abe Berger, Ph.D.
University of Kansas, 1960

1. Statement of The Problem. The studies summarized in this abstract constitute one part of a broad program on the investigation of specific metal effects in reactions of metal-cyclopentadienyl compounds.

2. Procedure. Studies to determine the nature of the decomposition products of ferrocenylphenylcarbinyl azide in chloroform-sulfuric acid (1:1 ratio), acetic acid which was 5M. in sulfuric acid and acetic acid which was 10M. in sulfuric acid have been undertaken. Studies have also been made of the effects of additives on the chemical behavior of ferrocenylphenylcarbinyl azide.

3. Findings. Whereas benzhydryl azide undergoes sulfuric acid-catalyzed decomposition to give nitrogen and the conjugate acid of benzal-aniline and a monosubstituted benzhydryl azide gives nitrogen and a mixture of the conjugate acids of two isomeric Schiff bases with the predominant isomer being the one predicted on the basis of analogy with other similar rearrangement reactions, fer-

rocenylphenylcarbinyl azide has now been found to behave in a most unusual manner. The latter azide was prepared by treatment of ferrocenylphenylcarbinol with hydrogen azide in benzene solution in the presence of trichloroacetic acid as catalyst and then subjected to the usual conditions of the Schmidt reaction. In chloroform-sulfuric acid (1:1 ratio), the most acidic medium, products resulting from two competing decomposition paths were obtained:

(1) The major course of the azide decomposition involved a "radical-ion" coupling reaction, a consequence of the unique character of α -metallocenyl carbonium ions. It is visualized that the conjugate acid of ferrocenylphenylcarbinyl azide undergoes ionization to give hydrogen azide and the ferrocenylphenylmethyl cation. The latter species then undergoes intramolecular oxidation-reduction with subsequent coupling to form bipositive cations of the stereoisomeric 1,2-diferrocenyl-1,2-diphenylethanes.

(2) Rearrangement products resulting from an exclusive migration of the phenyl group to a cationoid nitrogen atom in an otherwise normal Schmidt reaction have been isolated.

When the azide decomposition was carried out in acetic acid which was 5-10 molar in sulfuric acid, products resulting from solvolysis reactions in addition to the types cited above were obtained.

When the azide decomposition in chloroform-sulfuric acid (1:1 ratio) was carried out in the presence of benzaldehyde, N-benzoylferrocenylphenylcarbinylamine was isolated together with other products.

When the azide decomposition in chloroform-sulfuric acid (1:1 ratio) was carried out in the presence of benzaldehyde and benzhydryl azide, 1,1,2,2-tetraphenylethane was isolated together with other products.

Benzylferrocene was isolated in good yield by the reaction of ferrocenylphenylcarbinol with phosphorus(III) bromide.

4. Conclusions. The sole migration of the phenyl group in the Schmidt reaction of ferrocenylphenylcarbinyl azide has been attributed to the protonation of the ferrocene nucleus by the strong acid present in the reaction mixture. A phenyl group would be expected to migrate in preference to a protonated ferrocenyl group.

Whenever the ferrocenylphenylmethyl cation is generated in a strongly acidic medium, a radical ion is subsequently formed, and it can participate in a variety of free radical reactions. The formation of N-benzoylferrocenylphenylcarbinylamine, 1,1,2,2-tetraphenylethane and benzylferrocene are all manifestations of free radical reactions in which the ferrocenylphenylmethyl cation plays an important role.

Microfilm \$2.75; Xerox \$5.60. 115 pages.

PART I. THE STRUCTURE OF
PHOTOSANTONIC ACID
AND RELATED PRODUCTS.
PART II. STUDIES ON THE
CONSTITUTION OF RYANODINE.

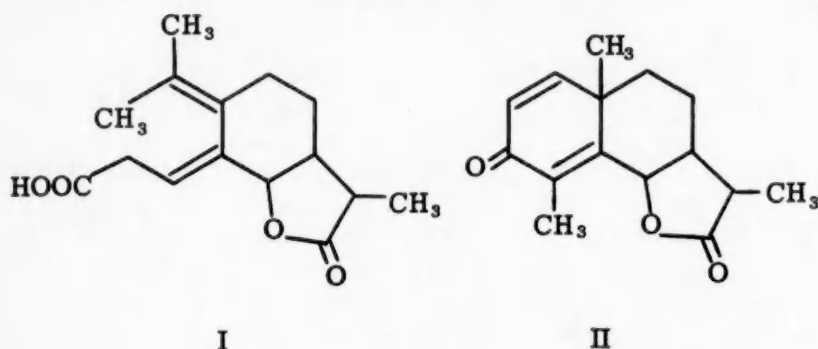
(Order No. 61-3089)

Gerald Stanley Brenner, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Eugene E. van Tamelen

Part I

Chemical and physico-chemical findings are presented which support structure (I) for photosantoninic acid, the well-known irradiation product of the sesquiterpene santonin (II). Various chemical transformations and the mechanism of formation of photosantoninic acid are discussed in terms of the developed structure.



Part II

Information is presented which bears on the constitution of ryanodine, an alkaloid of interest because of its insecticidal properties.

The crystalline extract of *Ryania speciosa* Vahl could be separated into three closely related substances, one of which was ryanodine ($C_{25}H_{35}NO_9$). Dehydroryanodine ($C_{25}H_{33}NO_9$), formed from ryanodine by the consumption of one mole of periodic acid, appears to be a β -keto ester on the basis of its behavior with base.

Ryanodine, on alkaline hydrolysis, afforded two fragments, pyrrole- α -carboxylic acid and a neutral compound, ryanodol ($C_{20}H_{32}O_8$). Dehydrogenation of ryanodol produced a $C_{11}H_{10}O_3$ aromatic species for which a chromone-type system is suggested.

Reduction of ryanodol by hydriodic acid-phosphorus leads to a mixture of acid and neutral materials from which a crystalline γ -lactone, $C_{20}H_{26}O_2$, was isolated. A suggested partial formulation for this lactone by earlier workers was shown to be incorrect. Treatment of the lactone with lithium aluminum hydride resulted in the formation of a $C_{20}H_{30}O_2$ diol which was subjected to selenium and palladium-on-carbon dehydrogenations. Spectral examinations and chemical behavior suggest that the major reaction product resulted from dehydration without subsequent dehydrogenation. In small yield, selenium dehydrogenation gave a compound or mixture of compounds having a phenanthrene skeleton.

Microfilm \$2.75; Xerox \$5.00. 96 pages.

VITAMIN B₆ DERIVATIVES AND
RELATED COMPOUNDS

(Order No. Mic 61-2255)

Houston George Brooks, Jr., Ph.D.
Iowa State University of Science and Technology, 1961

Supervisor: Dr. David E. Metzler

Interest in vitamin B₆, its chemistry and physiology has intensified continually since the inception of its existence. In recent years much attention has been focused on structures, requirements, and functions of hundreds of enzymes and enzyme systems. Among them the vitamin B₆ enzyme occupy a position of considerable prominence. Modern methods and techniques have made it possible to isolate and characterize many of these substances. Interest in the manner in which these materials accomplish their phenomenal physiological tasks has in part led to the present investigation, which had as its primary objective the synthesis of a series of model compounds of vitamin B₆, to be studied later in the hope of better understanding the role in certain enzyme systems.

A brief historical review of the literature pertaining to the discovery, isolation, structure determination and chemistry of pyridoxine, pyridoxal, pyridoxamine, pyridoxal phosphate and pyridoxamine phosphate has been presented.

Improved syntheses of pyridoxal, isopyridoxal, and isopyridoxamine have been described. Several new derivatives of each of these compounds have also been presented and they encompass such substances as halogen compounds, acids, malonic and acetamidomalonic esters, amines, imines, benzyl and *p*-nitrobenzyl chloride quaternary salts, acetals, ketals and an amino acid.

Oxidation of several of these compounds with manganese dioxide has been attempted with little success since in several cases there exist considerable doubt as to the exact structure of the products.

The 3-pyridylmethyl analog of thiamine was also prepared for study in an unrelated investigation.

In conclusion it might be merely mentioned that in a very elementary manner so far, several of these derivatives appear to be more active catalysts, in the nonenzymic transamination of certain amino acids than pyridoxal.

Microfilm \$2.75; Xerox \$5.00. 100 pages.

REARRANGEMENT OF
N-CHLORO IMINO ESTERS

(Order No. Mic 61-1966)

Jerald Edson Dirks, Ph.D.
The University of Nebraska, 1961

Adviser: Henry E. Baumgarten

In 1959 Petersen reported the preparation of α -amino-phenylacetic acid in very poor yield by hydrolyzing the intermediate obtained by treating a refluxing benzene solution of methyl N-chlorophenyliminoacetate with a solution of sodium methoxide in methanol. However, an attempt to prepare β -phenylalanine by the same method failed to give

any of that α -amino acid. The work described in the present paper has been carried out with the purpose of modifying the conditions of Petersen's procedure in order to arrive at a general, competitive reaction sequence for the preparation of α -amino acids.

Each iminoester hydrochloride used in this study was prepared in the usual manner by treating a cooled solution of an alkyl cyanide and methanol with hydrogen chloride. Whereas Petersen neutralized the iminoester salt and chlorinated the free iminoester with *tert*-butyl hypochlorite, only ethyl *N*-chloroiminohydrocinnamate was prepared in this study by this method. Each of the other *N*-chloro iminoesters was prepared by adding the iminoester salt to a cooled sodium hypochlorite solution. A dry *n*-pentane solution of the chloro compound was then added to a cooled methanol solution of sodium methoxide (for the preparation of α -aminophenylacetic acid) or to a cooled solution of potassium *tert*-butoxide in *tert*-butyl alcohol (for the preparation of glycine, alanine, norvaline, leucine, and β -phenylalanine). Hydrolysis of the resulting intermediate with boiling aqueous hydrochloric acid followed by neutralization gave the α -amino acid, while hydrolysis with cold hydrochloric acid gave the methyl ester hydrochloride of the amino acid.

By using the procedure summarized above, glycine, alanine, norvaline, leucine, and α -aminophenylacetic acid were prepared from the corresponding nitriles. The respective yields were 43.4, 51.0, 26.1, 59.3 and 51.1%. The methyl ester hydrochlorides of these five α -amino acids were prepared in yields of 47.2, 54.5, 32.1, 58.2, and 54.7%, respectively. β -Phenylalanine was prepared in 60.0% yield from the free iminoester.

This study of the base induced rearrangement of *N*-chloro iminoesters has shown with six examples that this procedure can be used to prepare α -amino acids and their methyl ester hydrochlorides in yields comparable to those obtainable from the more conventional methods of synthesis. Although additional studies of this reaction sequence must be carried out before the full scope of the rearrangement can be realized, this new synthetic route shows promise of being very useful for the preparations of α -amino acids when the corresponding nitriles are readily available or when they can be prepared easily from readily available materials.

Microfilm \$2.75; Xerox \$4.00. 75 pages.

THE CHEMISTRY OF DICYCLOPENTADIENE AND SOME OF ITS DERIVATIVES

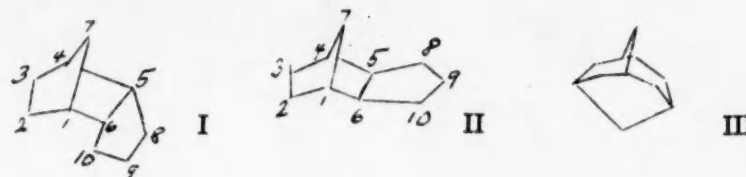
(Order No. Mic 61-1984)

Malcolm MacFarland Donaldson, Ph.D.
Princeton University, 1960

Part I - The Acid Catalysed Rearrangement of Trimethylenenorbornane:¹

Sulfuric acid and the aluminum halides catalyzed the isomerization of *endo*-trimethylenenorbornane (*endo*-tetrahydrodicyclopentadiene) to *exo*-trimethylenenorbornane II. At equilibrium, the distribution of isomers was 99% II and 1% I, as determined by vapor phase chromatography. This result contributes to the quantitative

interpretation of reactions and conformational analysis in this bridged system.



Further isomerization of either I or II to adamantane III in the presence of aluminum halide catalysts was discovered. The most effective conditions found employed an $\text{AlBr}_3\text{-HBr}$ co-catalyst system, with 2-butyl bromide promoter at room temperature. The yields of adamantane approached 20%. Several mechanisms for the *exo*-*endo* interconversion, as well as for the adamantane isomerization were considered. Several attempts to substantiate these mechanisms were made, but no conclusive results were obtained. With I, position 5 was identified as being the most prone to undergo hydride ion abstraction processes.

Part II - The Preparation and Solvolysis of Trimethylenenorbornanols:

A number of trimethylenenorbornanols were prepared, many for the first time. In order to evaluate the magnitude of steric effects upon reactivity, the acetolysis rates of the tosylates of these alcohols (table I) were determined. Neither rearrangement nor other evidence for participation was detected. The results are in agreement with the idea that molecular crowding, non-bonded repulsions, and/or hindrance to solvation can affect reactivity. The magnitude of these effects appears to be small to account for the large rate differences observed with certain epimerically related derivatives of norbornyl systems.

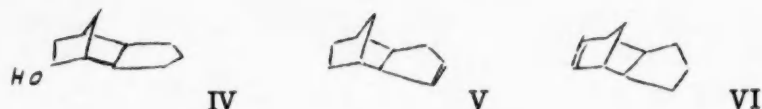
Table I

ALCOHOL	k_1 (25 °C)	Rel. Rates (25 °C)	H* kcal/mole	S* (25 °C)
	1.04×10^{-7}	1.26	26.7	-0.9
	1.56×10^{-8}	0.183	27.5	-1.9
	2.80×10^{-7}	3.38	25.1	-4.4
	1.48×10^{-8}	0.179	27.65	-1.6
	6.98×10^{-8}	0.843	26.9	-1.1
	$(9.65 \times 10^{-4} \text{ at } 100^\circ)$			
	9.27×10^{-7}	12.0	24.0	-5.6
	4.47×10^{-8}	0.054	28.5	-5.8
	2.44×10^{-5}	295	21.7	-6.9
	8.28×10^{-8}	1.0	25.8	-4.4

The effects of substituents upon the 6-position on the solvolysis rates of *exo*- and *endo*-norbornyl derivatives was also investigated (Table I). Methyl groups, surprisingly, depressed the rate of both isomers markedly. This effect was interpreted in the light of earlier observations of Bartlett and Barnes² of similar behavior with trimethylenene-2-norbornanol derivatives. The key step in the synthesis of the 6,6-dimethyl-2-norbornanols was the positionally selective reduction of 5,5-dimethylnorbornene epoxide with lithium aluminum hydride.

Part III - The Dehydration-Rearrangement of Trimethylenenorbornanols:

Exo-trimethylene-2-exo-norbornanol IV was dehydrated with 85% phosphoric acid and the product was shown to be exo-trimethylene-8-norbornene V and not exo-trimethylene-2-norbornene VI, as had been assumed previously in the literature.⁴ The scope of this rearrangement was examined by dehydrating other alcohols possessing the trimethylene-norbornane skeleton. Olefin VI also rearranged to V under the same conditions.



It was found that any compound that could give rise to carbonium ions VII and VIII, postulated intermediates in the reaction, gave olefin V as the product. Reaction mechanisms to account for these rearrangements and the driving forces were discussed.



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2. P. D. Bartlett, Abstracts, 12th National Org. Chem. Symposium, Denver, Colorado, June, 1951, p. 4-7; R. Barnes, Ph.D. Thesis Harvard University, 1950.
3. P. von R. Schleyer and M. M. Donaldson, *J. Am. Chem. Soc.*, **78**, 5702, (1956); cf., P. Wilder, Jr. and G. T. Youngblood, *Ibid.*, **78**, 5706, (1956).
4. H. S. Bruson and T. W. Riener, *Ibid.*, **70**, 2809, (1948); P. Wilder, Jr. and G. T. Youngblood, *Ibid.*, **78**, 3795, (1956).

Microfilm \$3.80; Xerox \$13.50. 296 pages.

THE SYNTHESIS AND ACID HYDROLYSIS OF METHYL ALPHA-D-GLUCOPYRANOSIDURONIC ACID

(Order No. 61-2906)

Dwight Buchanan Easty, Ph.D.
The Institute of Paper Chemistry,
affiliated with Lawrence College, 1961

Adviser: Edgar Dickey

Methyl α -D-glucopyranoside (I) was oxidized by air in the presence of a platinum-carbon catalyst to yield a crude product which was purified by conversion into crystalline methyl α -D-glucopyranosiduronic hydrazide (II). Barium hydroxide was used to hydrolyze the hydrazine off II and form pure barium (methyl α -D-glucopyranosid)uronate (III).

This preparation was the first synthesis of pure III, and it provided the first demonstration of the lability to basic hydrolysis of the hydrazine portion of II.

The initial portions of the hydrolysis of methyl α -D-glucopyranosiduronic acid (IV) (and I for comparative purposes) in normal sulfuric acid at 70, 80, and 90°C. were studied by measurement of the methanol evolved. First-order rate constants and energies of activation were determined. First-order rate constants, in $\text{min.}^{-1} \times 10^3$, for the hydrolysis of IV at 70, 80, and 90°C. are 0.113, 0.413, and 1.45, respectively. Rate constants, in $\text{min.}^{-1} \times 10^3$, for the hydrolysis of I at 70, 80, and 90°C. are 0.117, 0.748, and 3.14, respectively. A favorable comparison of rate constants for the hydrolysis of I with most published values has established the validity of the methanol determination used in this study for the calculation of hydrolysis rate constants.

The activation energy for the hydrolysis of IV (31,600 calories per mole) is in agreement with one recently determined from the measurements of optical rotation by Nakano and Rånby (Paper presented before the Cellulose Division of the American Chemical Society, New York City Meeting, September, 1960). The energy of activation for the hydrolysis of I (35,600 calories per mole) agrees with the most reliable published value.

Calculations based on hydrolysis data and rates of formation of furfural from glucuronic acid and from IV support the reaction sequence: hydrolysis of IV followed by degradation of glucuronic acid.

Theories have been found in the literature which suggest that the acid hydrolysis of uronosides is retarded by an inductive effect originating in the carboxyl group. However, activation energies for the hydrolysis of IV and of I obtained in this investigation have been interpreted to show that IV was not stabilized by an inductive effect.

Microfilm \$2.75; Xerox \$4.00. 73 pages.

CYCLIC AZO COMPOUNDS: PROPERTIES AND SYNTHETIC METHODS.

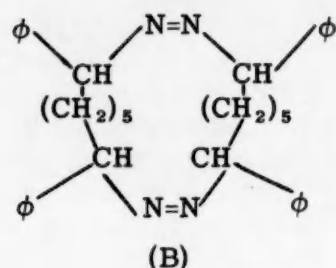
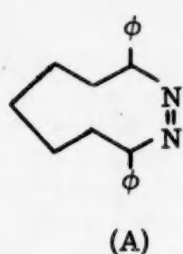
(Order No. Mic 61-1047)

John Richard Hall, Jr., Ph.D.
Polytechnic Institute of Brooklyn, 1961

Adviser: Charles G. Overberger

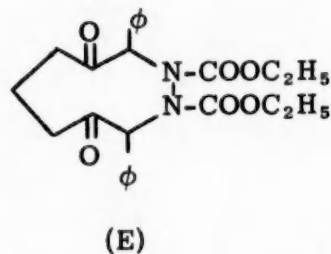
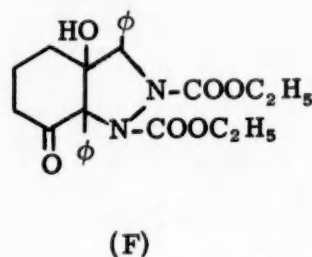
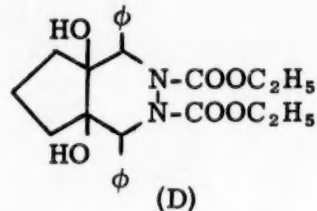
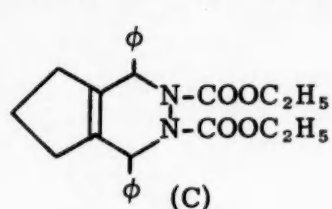
The purpose of this research was the synthesis of medium-sized cyclic azo compounds as possible sources of moderately active diradicals in solution. The predominant reaction of diradicals is intramolecular termination by coupling or disproportionation of the radical ends. This effect might be suppressed by medium-ring strain if coupling could produce only medium-sized rings. The synthesis of the nine-membered cyclic azo compound, 3,9-diphenyl-1,2-diazacyclononene (A), is of interest with respect to the anomalous thermal stability of 3,8-diphenyl-1,2-diazacyclooctene.

Attempted cyclization of two azine esters, methyl β -benzoylpropionate azine and methyl γ -benzoylbutyrate azine, to suitable cyclic azine intermediates by the acyloin condensation and the Dieckmann ring closure was unsuccessful. An eighteen-membered cyclic azine, 3,9,12,



18-tetraphenyl-1,2,10,11-tetraaza-2,9,11,18-cyclooctadecatetraene, resulted from an attempt to prepare the nine-membered cyclic azine, 3,9-diphenyl-1,2-diaza-2,9-cyclononadiene, by a high-dilution procedure which had previously given the eight-membered cyclic azine; the same procedure, however, had resulted in cyclic dimers when applied to the synthesis of the analogous ten-, twelve- and fourteen-membered cyclic azines. The azine was converted to the eighteen-membered cyclic azo compound, 3,9,12,18-tetraphenyl-1,2,10,11-tetraaza-1,10-cyclooctadiene (B), by hydrogenation, followed by oxidation with mercuric oxide.

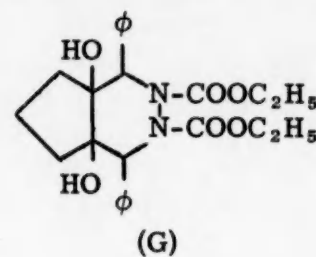
The Diels-Alder adduct of 1,2-dibenzylidenecyclopentane and ethyl azodicarboxylate, 3,4-dicarbethoxy-2,5-diphenyl-3,4-diaza- $\Delta^1(6)$ -bicyclo[4,3,0]nonene (C), was converted to a nine-membered cyclic diketone, 1,2-dicarbethoxy-3,9-diphenyl-1,2-diaza-4,8-cyclononanedione (E) by hydroxylation with osmium tetroxide followed by cleavage with lead tetraacetate.



The diketone readily underwent an acid-catalyzed intramolecular aldol condensation to give a bicyclic compound, 1-hydroxy-7,8-dicarbethoxy-6,9-diphenyl-7,8-diaza-5-bicyclo[4,3,0]nonanone (F). Attempts to convert the diketone to the nine-membered cyclic azo compound by reduction of the ketone groups to methylene groups and subsequent removal of the carbethoxy groups were unsuccessful.

Hydroxylation of the adduct (C) with hydrogen peroxide-osmium tetroxide (Milas' reagent), a *cis*-hydroxylating reagent, gave a compound isomeric with the *cis*-diol, D, obtained by hydroxylation of the adduct with osmium tetroxide. This compound is resistant to cleavage by lead tetraacetate and is tentatively assigned the structure of a *trans*-diol, G. Treatment of the adduct with performic acid did not give the expected *trans*-diol, G. The compound isolated, although resistant to hydrolysis, corresponds to the intermediate oxide.

The dipole moments in benzene of 3,7-diphenyl-1,2-diazacycloheptene, 3,8-diphenyl-1,2-diazacyclooctene, and 1-azo-bis-1-phenylpropane were found to be 3.1 ± 0.5 , $1.14 \pm$



0.04 and 0.35 ± 0.08 D, respectively. These results prove the *cis*-azo structure of the seven-membered cyclic azo compound and the *trans* structure of the linear azo compound. The eight-membered cyclic azo compound is concluded to be a *trans*-azo compound on the basis of the dipole moment of 1.14 D and comparisons of the ultraviolet absorption spectrum.

Microfilm \$2.75; Xerox \$5.00. 99 pages.

ION-EXCHANGE RESIN CATALYSIS OF THE KNOEVENAGEL CONDENSATION OF KETONES

(Order No. 61-3306)

Richard William Hein, Ph.D.
Case Institute of Technology, 1961

Weakly basic ion-exchange resins and their organic salts are shown to be effective catalysts for the Knoevenagel condensation of various unhindered ketones with various cyano active methylene compounds. The effect of several ion exchangers was compared with the effect of several homogeneous catalysts. It was found that mixtures of acetic acid and the weakly basic exchange resin, Dowex 3, were as effective as, and in some cases more effective than, the better homogeneous catalysts reported in the literature, e.g., piperidine acetate, p-aminophenol, and ammonium acetate-acetic acid mixtures.

The reactivity of any ketone with ethyl cyanoacetate and with resin catalysis depends, in general, upon the size or bulkiness of the alkyl or aryl groups bound to the carbonyl carbon. Branching at the alpha carbons of the ketone markedly reduces the percent conversion to product.

The only active methylene compounds (ZCH_2X) which undergo reaction with cyclohexanone and resin catalysis are those in which $X = CN$ and $Z =$ an electron-withdrawing group. Also, little or no reaction occurs if Z is separated from the $-CH_2CN$ group by a benzene ring.

The ion-exchange catalyzed reactions studied in this work are almost completely free of by-products. In general, the only product detected was the alpha,beta-unsaturated nitrile of the type $R(R')C=C(Z)CN$.

A concerted type mechanism is postulated.

Microfilm \$2.75; Xerox \$3.00. 52 pages.

SYNTHESES WITH HEMIMELLITIC ACID AND RELATED COMPOUNDS

(Order No. Mic 61-2260)

David Bruce Randolph Johnston, Ph.D.
Iowa State University of Science and Technology, 1961

Supervisor: Ernest Wenkert

The Diels-Alder adduct of maleic acid and furfurylamine acetate, upon treatment with sodium hypiodite underwent cyclization to form an iodolactone. Through a series of reactions, a benzenesulfonamidomethylacetylbenzoic acid could be obtained, the structure of which depended upon which carboxyl group in the Diels-Alder adduct underwent lactonization. Synthesis of the aromatic compound was achieved through the following series of reactions: hemimellitic acid \rightarrow 3-carboxyphthalic anhydride \rightarrow 7-carboxyphthalide \rightarrow 7-hydroxymethylphthalide \rightarrow 7-chloromethylphthalide \rightarrow 7-(2-phthalimidomethyl)-phthalide \rightarrow 7-hydroxymethylphthalimidine \rightarrow 7-formylphthalimidine \rightarrow 7-(α -hydroxyethyl)-phthalimidine \rightarrow 7-acetylphthalimidine \rightarrow 2-carboxy-3-benzenesulfonamidomethylacetophenone.

The formation of the phthalide acid and alcohol was accompanied by the formation of 4-carboxy-, 4-formyl-, and 4-hydroxymethyl-2,4-isobenzofuran.

Reduction of hemimellitic anhydride with zinc and acetic acid led to both 4- and 7-carboxyphthalide. Oxidation of 1,2,3-trihydroxymethylbenzene has given 4-carboxyphthalide.

The methyl esters of both isomeric acids were prepared, as well as the amide and nitrile of the 4-isomer.

The Arndt-Eistert reaction on the two phthalide acids led to the corresponding homologous methyl esters.

Synthesis of 4-cyanophthalimide was achieved through 4-carboxamidophthalimide. Reduction of the nitrile with zinc and acetic acid led to at least six compounds, two of which analyzed correctly for phthalimidine nitriles.

Reduction of 6-carboxyphthalonic acid led to 3,4-dicarboxyphthalide which decarboxylated upon heating to give 4-carboxyphthalide. Pyrolysis of 6-carboxyphthalonic acid afforded significant quantities of 4-carboxyphthalonic acid, along with at least three other compounds. Only the last three products have been reported before from this reaction.

Synthesis of 3-carbomethoxyphthalic acid was achieved through 4-carbomethoxyphthalic anhydride. A dimethyl ester was obtained and is believed to be dimethyl 3-carboxyphthalate.

Microfilm \$2.75; Xerox \$6.20. 127 pages.

CERTAIN ASPECTS OF THE CHEMISTRY OF SOME PYRAZINE DERIVATIVES

(Order No. 61-3263)

Marwan R. Kamal, Ph.D.
University of Pittsburgh, 1961

The purpose of this study was to develop synthetic procedures for the preparation of certain pyrazine derivatives.

The side chain of 2,6-dimethylpyrazine has been metalated using sodium amide in liquid ammonia as the condensing agent. 2-Methyl-6-acylatedpyrazines were obtained when the 2-methyl-6-pyrazylmethylsodium was treated with the following ethyl esters: benzoate (53.5%), anisate (83.6%), o-chlorobenzoate (70.0%), isonicotinate (72.7%), 2-furoate (71.5%), 2-thenoate (62.0%), acetate (17.4%), propionate (58.5%), n-butyrate (65.6%), isobutyrate (82.5%), and pivalate (80.5%).

2-Methyl-6-alkylatedpyrazines were obtained when the 2-methyl-6-pyrazylmethylsodium was treated with the following halides: ethyl bromide (54.4%), n-propyl bromide (68.4%), isopropyl bromide (69.3%), n-butyl bromide (81.5%), isobutyl bromide (98.5%), n-amyl bromide (85.3%), benzyl chloride (72.6%), beta-dimethylaminoethyl chloride (77.5%), and propargyl bromide (45.0%).

Aldol-type condensations leading to 2-methyl-6-pyrazylmethylcarbinols were also effected by treating the 2,6-dimethylpyrazine anion with the following aldehydes and ketones: benzaldehyde (58.0%), cinnamaldehyde (78.5%), isobutyraldehyde (25.6%), acetone (37.7%), methyl ethyl ketone (58.3%), methyl isopropyl ketone (38.5%), diethyl ketone (62.2%), cyclopentanone (27.3%), cyclohexanone (47.0%), acetophenone (54.5%), propiophenone (45.8%), and benzophenone (100%).

The carbinols which were obtained from the aldol-type condensation of 2,6-dimethylpyrazine with the following aldehydes and ketones: acetone, methyl ethyl ketone, methyl isopropyl ketone, diethyl ketone, cyclohexanone, benzaldehyde, acetophenone, propiophenone, benzophenone, and cinnamaldehyde, were dehydrated using iodine as a catalyst to give the following yields of the expected olefins: 68.4%, 89.7%, 74.5%, 48.9%, 40.9%, 51.4%, 65.1%, 44.6%, 90.0%, and 50.5%, respectively.

Using the sodium amide-liquid ammonia method, 1-pyrazyl-3-dimethylaminopropane was condensed with the following ethyl esters to give the corresponding ketones: benzoate (99.5%), isonicotinate (89.5%), isobutyrate (81.5%), and acetate (16.4%).

Aldol-type products were also obtained when 1-pyrazyl-3-dimethylaminopropane was treated with the following ketones to yield the corresponding carbinols: benzophenone (81.0%), 2-acetylthiophene (65.0%), and methyl ethyl ketone (58.0%).

The alkylation of phenacylpyrazine with beta-dimethylaminoethyl chloride to give the enol ether (O-alkylated product), [(1-phenyl-2-pyrazyl)-1-ethenyl] 2-dimethylaminoethyl ether (40.0% yield), was accomplished by using sodium amide in liquid ammonia for the formation of the anion, and then refluxing the anion with the halide in toluene for 33 hours.

Vinylpyrazine was synthesized by a Hofmann exhaustive methylation reaction on the Mannich base, beta-dimethylaminoethylpyrazine, which was obtained from the reaction of methylpyrazine with formaldehyde and dimethylamino hydrochloride in a 64.2% yield. The beta-dimethylaminoethylpyrazine was treated with methyl iodide to form the quaternary compound which was then converted to vinylpyrazine either by treating it with silver hydroxide to yield vinylpyrazine (63.3%) or by refluxing the quaternary ammonium iodide with aqueous sodium hydroxide to yield vinylpyrazine (60.5%).

Symmetrical 2,6-diacylated pyrazines were synthesized by starting with the monoacylated compounds and acylating them with esters. The following diketones were prepared:

2,6-diphenacylpyrazine (91.0%), 2,6-di-(propionylmethyl)-pyrazine (75.4%), 2,6-di-(isobutyrylmethyl)-pyrazine (42.0%), and 2,6-di-(pivalylmethyl)-pyrazine (19.8%). 2,6-Diphenacylpyrazine and 2,6-di-(isobutyrylmethyl)-pyrazine were also synthesized in 38.5% and 0.6% yields, respectively, by starting with 2,6-dimethylpyrazine and diacylating it.

Starting with 2-methyl-6-(pivalylmethyl)-pyrazine it was possible to synthesize unsymmetrical diacylated products with the following esters: methyl isonicotinate (97.6%), and methyl propionate (47.0%).

When pyrazylmethylsodium was treated with styrene oxide, the epoxide ring was opened at the primary carbon atom leading to the secondary alcohol, 1-phenyl-3-pyrazylpropanol-1, (72.7%). The structure of this carbinol was established by oxidation with acidic potassium dichromate to phenyl 2-pyrazylethyl ketone (58.8%).

Microfilm \$2.75; Xerox \$6.00. 125 pages.

PREPARATION AND DECOMPOSITION OF AZO COMPOUNDS:

PART I. OXIDATION DECOMPOSITION PRODUCTS OF 3,6-DICYANO-3,6-DIMETHYL- 1,2,4,5-TETRAHYDROPYRIDAZINE.

PART II. PREPARATION AND DECOMPOSITION OF 3,6-DIMETHYL-3-PHENYL- 2,4,5-TRIHYDROPYRIDAZINE.

(Order No. Mic 61-1048)

George Kesslin, Ph.D.

Polytechnic Institute of Brooklyn, 1961

Adviser: Charles G. Overberger

PART I.

Previous work on the oxidative decomposition of 3,6-dicyano-3,6-dimethylpiperidazine had resulted in the isolation of a single product. This was tentatively assigned the structure, dicyanodimethylcyclobutane. It was for the purpose of confirming the structure of this solid, identifying the remaining products of the oxidation, and elucidating the stereochemical consequences of the reaction that this study was undertaken.

As a result of the present work, it was found that the preparation of 3,6-dicyano-3,6-dimethylpiperidazine could be carried out by the reaction of sodium cyanide and aqueous sulfuric acid on the low-boiling and high-boiling tautomers of 3,6-dimethyldihydropyridazine. The preparation of this cyclic hydrazine was also achieved in one step from acetonylacetone, hydrazine sulfate, and sodium cyanide.

Two products were isolated from the oxidation of the cyclic hydrazine. One was identified as methacrylonitrile by physical constants, infrared spectrum, and conversion to methacrylamide. The other, already postulated as dicyanodimethylcyclobutane, was shown to be *trans* by acid hydrolysis and comparison of the dicarboxylic acid formed with the *trans*-diacid previously reported.

Alkaline hydrogen peroxide hydrolysis of the dicyanodimethylcyclobutane yielded the hitherto unreported *trans*-1,2-dicarboxamido-1,2-dimethylcyclobutane.

Attempts to establish the stereochemical configuration of the cyclic hydrazine by resolution of the possible *trans*-isomer with optically active acids resulted instead in the loss of a mole of hydrogen cyanide and in the formation of salts of the acids with dimethylcyanotetrahydropyridazine. Attempts to prepare dicarboxydimethylpiperidazine for resolution with an optically active base, resulted instead in the formation of the hitherto unreported dimethylcarboxytetrahydropyridazine.

PART II.

As part of a program involving the preparation of azo compounds that may be precursors for biradicals, and in a continuation of the study of the preparation and behavior on oxidation of 1,2-disubstituted cyclic hydrazines, the preparation of 6-membered ring azo compounds unsymmetrically substituted in the 3- and 6-positions was undertaken.

As a result of this study 3,6-dimethyl-3-phenyl-2,3,4,5-tetrahydropyridazine was prepared by the addition of phenyllithium to 3,6-dimethyldihydropyridazine.

The hydrochloride of the unsymmetrical cyclic hydrazine was prepared and found to be more stable than the free base.

The free hydrazone and its hydrochloride were quantitatively hydrogenated over platinum oxide to give the corresponding cyclic hydrazine.

The cyclic hydrazine was found to be extremely unstable and was isolated only as its hydrochloride salt. Attempted isolation of the free base resulted in its rapid oxidation and rearrangement to the parent hydrazone.

Attempted oxidation of the cyclic hydrazine to the cyclic azo compound resulted only in the isolation of cyclic hydrazone.

The N,N'-dinitroso compound of the cyclic hydrazine was prepared by the reaction of aqueous nitrous acid with the cyclic hydrazine hydrochloride. It melted with decomposition and the evolution of nitric oxide.

Thermal decomposition of the dinitroso compound, in the attempt to obtain the unsymmetrical cyclic azo compound, resulted in the isolation of the cyclic hydrazone.

Although our efforts to isolate the cyclic azo compound failed, the cyclic hydrazone could be decomposed at 250-260°, over potassium hydroxide and platinized pumice stone, to yield nitrogen, α -methylstyrene, propylene, *cis*- and *trans*-1,2-dimethyl-1-phenylcyclobutane and a small amount of acetophenone. The azo compound was probably an unstable intermediate in the decomposition.

Microfilm \$2.75; Xerox \$4.80. 94 pages.

FURTHER INVESTIGATIONS IN THE SUBSTITUTED AMIDE REACTION

(Order No. Mic 61-2601)

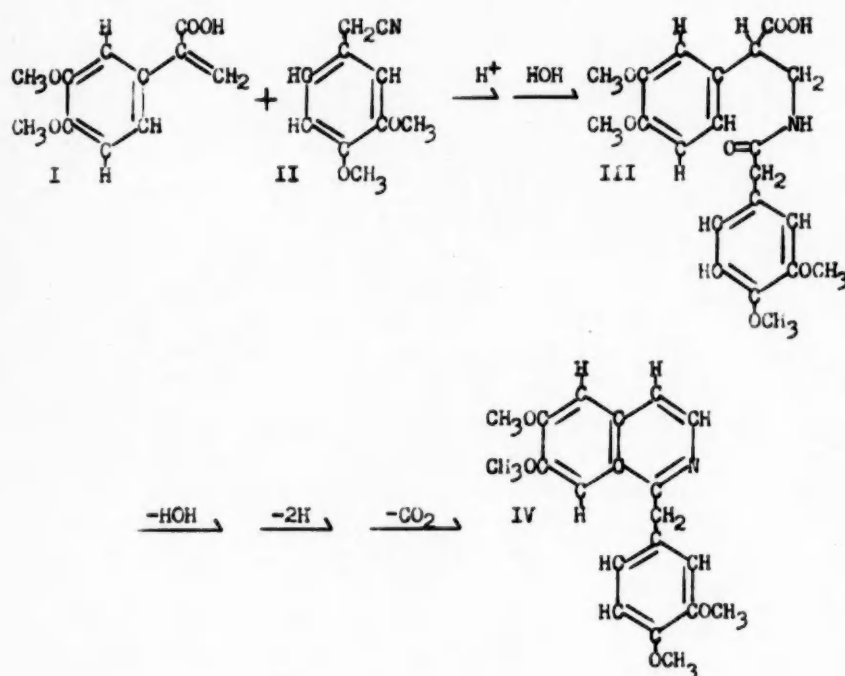
Benjamin Lipka, Ph.D.
New York University, 1958

Adviser: Professor John J. Ritter

Introduction

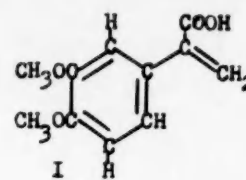
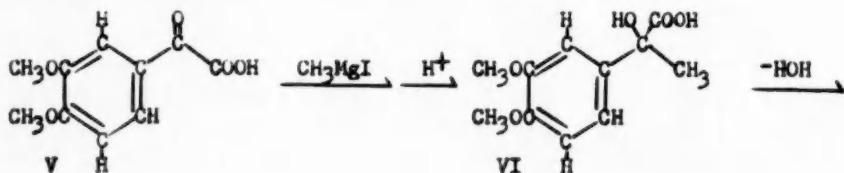
The initial purpose of this investigation was the synthesis of N-acyl or N-aroyle- β -carboxy- β -arylethylamines by the condensation of atropic acids with nitriles in a substituted amide reaction.¹ At the same time it was hoped that these N-acyl or N-aroyle- β -carboxy- β -aryl-ethylamines could be converted to isoquinolines by cyclodehydration, dehydrogenation, and decarboxylation.

The initial goal of this investigation was the synthesis of N-homoveratroyle- β -carboxy- β -(3,4-dimethoxyphenethyl)amine (III) by the condensation of 3,4-dimethoxyatropic acid (I) with homoveratronitrile (II) in the hope that it could be converted to papaverine (IV) by cyclodehydration, dehydrogenation, and decarboxylation.



The synthesis of 3,4-dimethoxyatropic acid

Since 3,4-dimethoxyatropic acid was an unknown compound, an investigation was undertaken to find a method of synthesis of an intermediate compound that would yield 3,4-dimethoxyatropic acid. Several methods of synthesis were tried but with no success. Finally, the synthesis of 3,4-dimethoxyatrolactic acid (VI), an intermediate compound that could be dehydrated to 3,4-dimethoxyatropic acid (I), although in low yield, was achieved by the reaction of 3,4-dimethoxybenzoylformic acid (V) with methylmagnesium iodide.

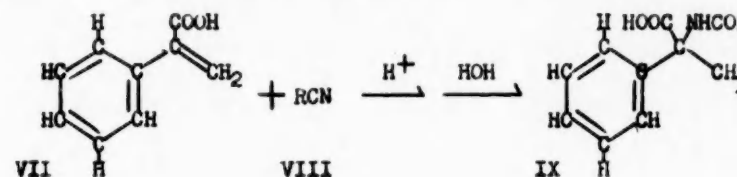


The condensation of atropic acid with nitriles

Since it was found that the synthesis of 3,4-dimethoxyatropic acid was time-consuming and the yields were low, and since it was not known whether 3,4-dimethoxyatropic acid would condense with nitriles, an investigation of the condensation of the easily synthesized atropic acid with nitriles was undertaken.

It was felt that if atropic acid condensed with nitriles and the products formed were the desired N-acyl- β -carboxy- β -phenethylamines rather than the undesirable α -amido acids, then a large-scale preparation of 3,4-dimethoxyatropic acid would be undertaken.

It was found that atropic acid (VII) condensed with phenylacetone nitrile (VIII; R = C₆H₅CH₂-) and acetonitrile (VIII; R = CH₃-) to yield α -methyl- α -phenylphenacetic acid (IX; R = C₆H₅CH₂-) and N-acetyl- α -phenylalanine (IX; R = CH₃-), both of which are α -amido acids.



The formation of α -amido acids in the above reaction indicated that the initial goal of this investigation (the synthesis of papaverine) might not succeed because the desired N-homoveratroyle- β -carboxy- β -(3,4-dimethoxyphenethyl)amine could not be synthesized by the reaction of 3,4-dimethoxyatropic acid with nitriles, and the investigation along these lines was abandoned.

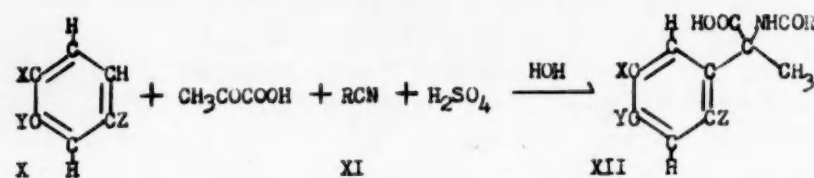
The synthesis of N-acyl- α -arylalanines

One proposed method of synthesis of 3,4-dimethoxyatropic acid that was not successful involved the reaction of α -(3,4-dimethoxyphenyl)alanine hydrochloride with nitrous acid. The amino acid hydrochloride was prepared by the hydrolysis of N-acetyl- α -(3,4-dimethoxyphenyl)alanine synthesized by the reaction of veratrole with pyruvic acid and acetonitrile in a sulfuric-acetic acid solution in what is believed to be a modification of the substituted amide reaction. As a result, it was decided to investigate this reaction as a possible general method of synthesis of N-acyl- α -arylalanines.

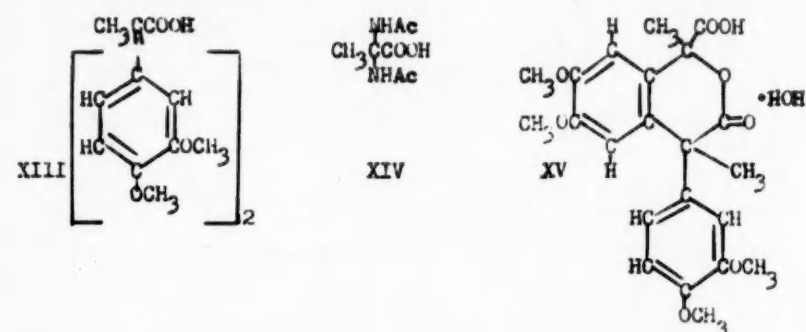
The reaction was carried out with several phenolic ethers. It was found that only anisole (X; X = Z = H-, Y = CH₃O-), veratrole (X; X = Y = CH₃O-, Z = H-), and hydroquinone dimethyl ether (X; X = Z = CH₃O-, Y = H-) reacted with a solution of pyruvic acid, acetonitrile (XI; R = CH₃-), and sulfuric acid to yield products that are believed to be N-acetyl- α -(p-methoxyphenyl)alanine (XII; X = Z = H-, Y = CH₃O-, R = CH₃-), N-acetyl- α -(3,4-dimethoxyphenyl)alanine (XII; X = Y = CH₃O-, Z = H-, R = CH₃-), and N-acetyl- α -(2,5-dimethoxyphenyl)alanine (XII; X = Z = CH₃O-, Y = H-, R = CH₃-) respectively.

Various other nitriles were reacted similarly with

anisole (X; X = Z = H-, Y = CH₃O-), pyruvic acid and sulfuric acid. Only acetonitrile (XI; R = CH₃-) and phenylacetonitrile (XI; R = C₆H₅CH₂-) reacted to yield products that are believed to be N-acetyl- α -(p-methoxyphenyl)-alanine (XII; X = Z = H-, Y = CH₃O-, R = CH₃-) and α -methyl- α -(p-methoxyphenyl)-phenacetic acid (XII; X = Z = H-, Y = CH₃O-, R = C₆H₅CH₂-) respectively.

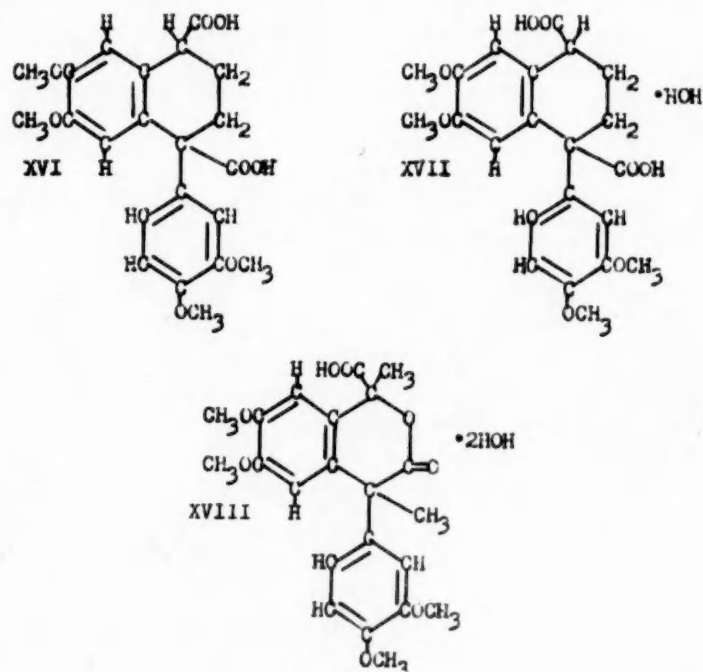


The reaction mixture that yielded N-acetyl- α -(3,4-dimethoxyphenyl)alanine was investigated further and was found to yield other products that are believed to be α , α -bis-(3,4-dimethoxyphenyl)propionic acid (XIII), α , α -bis-(acetamido)propionic acid (XIV), and a lactonic acid dimer of 3,4-dimethoxyatropic acid, α -di-3,4-dimethoxyatropic acid monohydrate (XV).



The preparation of three compounds believed to be dimers of 3,4-dimethoxyatropic acid from 3,4-dimethoxyatrolactic acid and 3,4-dimethoxyatropic acid

It was found that when 3,4-dimethoxyatrolactic acid was refluxed with dilute acid or when 3,4-dimethoxyatropic acid was refluxed with water or dilute acid, two substances believed to be dimers of 3,4-dimethoxyatropic acid were produced. These dimers are believed to be stereoisomeric diacidic compounds, α -3,4-dimethoxyisatropic acid (XVI) and β -3,4-dimethoxyisatropic acid monohydrate (XVII).



It was also found that when 3,4-dimethoxyatrolactic acid or 3,4-dimethoxyatropic acid was dissolved in a sulfuric-acetic acid solution, what was also believed to be a lactonic acid dimer of 3,4-dimethoxyatropic acid was isolated. This material, β -di-3,4-dimethoxyatropic acid dihydrate (XVIII), is believed to be stereoisomeric with α -di-3,4-dimethoxyatropic acid monohydrate (XV).

1. The substituted amide reaction is a general reaction whereby N-alkylamides have been synthesized by the condensation of nitriles with olefins or tertiary alcohols in sulfuric acid.

Microfilm \$2.75; Xerox \$6.00. 124 pages.

PART I: THE THERMAL CYCLIZATION OF DIOLEFINS.

PART II: RACEMIZATION AND DOUBLE BOND MIGRATION DURING HYDROGENATION OF OPTICALLY ACTIVE OLEFINS.

(Order No. 61-3061)

Norman Lewis Madison, Ph.D.
Ohio University, 1961

Director: William D. Huntsman

I. Certain acyclic olefins undergo cyclization at elevated temperatures. An investigation was undertaken to determine whether this thermal cyclization reaction might be extended to include monocyclic diolefins with one double bond in a six-membered ring and the other double bond properly situated in a side chain. For this purpose, three previously unreported diolefins, 3-(5-methyl-4-hexenyl)-cyclohexene, 3-(4-hexenyl)cyclohexene and 1-(5-methyl-4-hexenyl)cyclohexene, were prepared and evidence supporting their structure was obtained. These diolefins failed to undergo cyclization at temperatures up to 500°.

Several other compounds were prepared and characterized during this study.

II. Racemization occurs to the extent of 5.7-9.4 per cent during the hydrogenation of optically active 3-phenyl-1-butene in the presence of palladium charcoal. The mode by which this racemization takes place was investigated. When 50% of the theoretical quantity of hydrogen is absorbed, the unreacted olefinic material contains 9 per cent 2-phenyl-2-butene. The racemization must therefore be due principally to double bond migration.

A portion of this investigation was devoted to determining the factors which influence the extent of racemization during catalytic hydrogenation of optically active 3,7-dimethyl-1-octene in the presence of palladium on charcoal. The extent of racemization with small catalyst to olefin ratios is less than with larger ratios. In the presence of added potassium hydroxide the reaction stops before completion and at the point of this cessation, the alkane is unracemized. The theoretical amount of hydrogen is absorbed if the catalyst is pre-treated with potassium hydroxide and then washed with ethanol to remove most of the base. Racemization is less, however, than with untreated catalyst. Racemization is also slightly decreased when palladium oxide is used instead of palladium

on charcoal. In the presence of Lindlar catalyst the olefin is slowly hydrogenated to completion. Racemization with this catalyst is considerably less than with palladium on charcoal.

When benzene is used as the solvent instead of ethanol the reaction stops at 47% of completion. At this point the only remaining olefin is 3,7-dimethyl-2-octene.

These observations have been rationalized in detail.

Microfilm \$2.75; Xerox \$6.60. 137 pages.

THE HYDROLYSIS OF CYANOPYRIDINIUM IONS

(Order No. 61-3147)

James Winton Patton, Ph.D.
The University of Wisconsin, 1961

Supervisor: Assistant Professor E. M. Kosower

The investigation of the alkaline hydrolysis of 1-methyl-2-cyanopyridinium ion, 1-methyl-3-cyanopyridinium ion, and 1-methyl-4-cyanopyridinium ion was carried out by polarographic and spectrophotometric means.

The hydrolysis products of 1-methyl-2-cyanopyridinium perchlorate were shown to be 1-methyl-2-pyridone and 1-methyl-2-carboxamidopyridinium perchlorate. The products were separated by the use of an ion-exchange column and characterized by comparison of their ultra-violet and infra-red absorption spectra and melting points with those of authentic samples.

The kinetics were followed by polarographic examination of the diffusion current of the liberated cyanide ion in thermostatted buffer solutions. The kinetics were studied at 10.3°, 25.2° and 39.1°. When the second-order rate constants were fitted to the Arrhenius equation, they gave 1.66×10^{12} as the frequency factor and 14.36 kcal./mole as the activation energy.

The ratio of the products was found to vary with pH. This suggests that the proposed intermediate, 1-methyl-2-pyridone cyanohydrin, has a pK_a of 10.3.

The alkaline hydrolysis of 1-methyl-4-cyanopyridinium perchlorate was studied in an exactly analogous manner. The hydrolysis products were shown to be 1-methyl-4-pyridone and 1-methyl 4-carboxamidopyridinium perchlorate and they were characterized by comparison of their melting points and ultra-violet and infra-red absorption spectra with those of authentic samples.

The kinetic study of the alkaline hydrolysis of 1-methyl-4-cyanopyridinium perchlorate was done polarographically at the same temperatures as above and the second-order rate constants fitted to the Arrhenius equation, giving 1.38×10^{11} as the frequency factor and 14.88 kcal./mole as the activation energy.

A cyanohydrin intermediate is proposed, 1-methyl-4-pyridone cyanohydrin, and the variation of the product ratio with pH suggests that it has a pK_a of 11.7.

The hydrolysis products of 1-methyl-3-cyanopyridinium perchlorate were shown to be 1-methyl-3-carboxamidopyridinium perchlorate and 4-cyano-5-methylamino-2,4-pentadienal, N.M.R. evidence being presented for the latter product.

The kinetics for the alkaline hydrolysis of the 3-cyano

salt were followed by ultra-violet absorption spectroscopy at 10.3°, 25.0° and 39.1°. The second-order rate constants were fitted to the Arrhenius equation giving 5.75×10^9 as the frequency factor, and 14.13 kcal./mole as the activation energy.

The second-order rate constants in all of these studies have an error of approximately 5%, due mainly to the uncertainty of the hydroxide ion concentration of the buffers.

The association equilibrium constants for the charge-transfer complexes of 1-methyl-4-cyanopyridinium iodide and 1-ethyl-4-cyanopyridinium iodide were measured and found to be quite similar.

The second charge-transfer band of various cyanopyridinium iodides was measured in methylene chloride. The 3-cyanopyridinium iodides exhibit a third unexplained band.

The shift of the ultra-violet absorption maxima of 1-methyl-2-pyridone and 1-methyl-4-pyridone in various solvents was investigated.

Microfilm \$2.75; Xerox \$9.45. 207 pages.

THE TOTAL SYNTHESIS OF dl-AJMALICINE

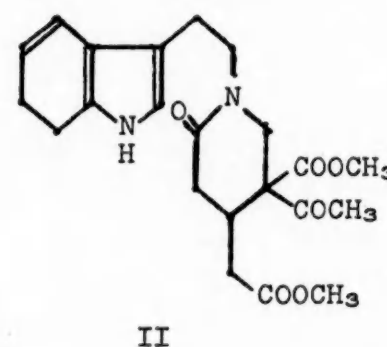
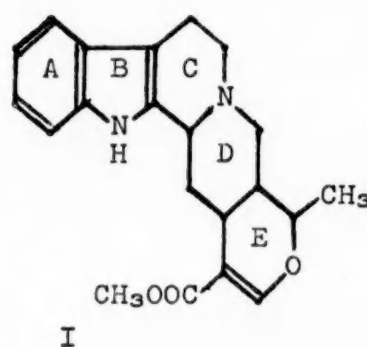
(Order No. 61-3149)

Carlton Placeway, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Eugene E. van Tamelen

A total synthesis of dl-ajmalicine (I), an alkaloid obtained from *Rauwolfia*, is described.

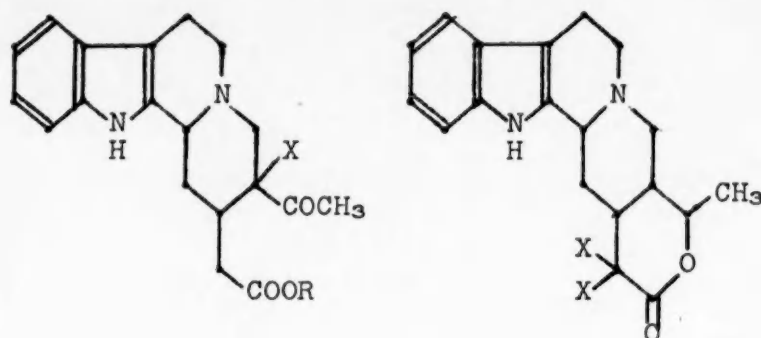
In a key step which roughly parallels the presumed biogenetic process, the essentials of the desired alkaloidal system are efficiently assembled at the outset: tryptamine, formaldehyde, and methyl 3-carbomethoxymethyl-4-carbomethoxy-5-ketohexanoate undergo a Mannich condensation in *t*-butyl alcohol, providing the lactam (II) in nearly quantitative yield.



Ring-C was fashioned by means of Bischler-Napieralsky cyclization to the tetracyclic Δ^3 -dehydro base and then reduction over palladium-on-carbon in ethanol to the keto diester (IIIa).

Removal of the ester function from the β -keto ester moiety was accomplished by prolonged heating of IIIa in refluxing dilute hydrochloric acid. The resulting keto acid (IIIb) was accompanied by varying amounts of diacid formed by acid catalyzed deacetylation of IIIa.

In preparation for the construction of the E-ring, keto acid IIIb was reduced with sodium borohydride to the



IIIa (X = COOCH₃; R = CH₃) IVa (X = H)
 IIIb (X = H; R = H) IVb (X = CHOH)

hydroxyacid, which, on treatment with N,N'-dicyclohexylcarbodiimide was converted to the δ -lactone (IVa). Conversion to the α -hydroxymethylene- δ -lactone (IVb) was effected by treatment of IVa with methyl formate in the presence of excess triphenylmethyl sodium in dioxane. Upon being heated in refluxing methanolic hydrogen chloride, the hydroxymethylene lactone was transformed readily to the dihydropyran carboxylic ester. Infrared spectral comparison (chloroform solution) of authentic ajmalicine with the base thus produced demonstrated the latter to be *dl*-ajmalicine.

Microfilm \$2.75; Xerox \$3.00. 50 pages.

CONFORMATIONAL ASPECTS OF OLIGOMERIC PEPTIDES

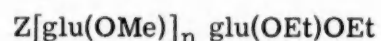
(Order No. Mic 61-1051)

Edward Emil Schmitt, Ph.D.
 Polytechnic Institute of Brooklyn, 1961

Adviser: Murray Goodman

The definitive work of Pauling and co-workers on the conformation of peptides led to many advances in the study of the structural arrangements of proteins and synthetic polypeptides. The α -helical conformation, which can be assumed by portions or by an entire peptide chain, occurs in many proteins in relatively short segments. A major objective of this dissertation was to determine the minimum size of a peptide necessary to form the intramolecular hydrogen bonds of a helical structure.

In order to carry out a study of this nature, a series of benzyloxycarbonyl-blocked oligomeric peptides were prepared:



These compounds consist of two to eleven residues of γ -esters of L-glutamic acid linked through peptide bonds. These materials were synthesized by a variety of techniques, including coupling by mixed anhydrides, active esters and combinations of the two. Equilibrium ultracentrifugation experiments in polar solvents have been useful in confirming the molecular weight of the oligomeric peptides. In an effort to check the optical purity of these materials, the pentapeptide was degraded to afford essentially optically pure L-glutamic acid.

Conformational studies in the solid state were attempted using such means as X-ray powder diagrams,

infrared spectra, and infrared dichroism, but these proved to be inconclusive. Various conformations of these oligomeric peptides in solution, however, could be detected by optical rotation measurements, infrared analysis, and molecular weight determinations. Helix or folded forms could be perceived by observing positive deviations from the expected specific rotations of the peptides. These effects were noted in helix-forming solvents. The optical rotatory dispersion constant, b_0 , was also useful in describing the helical conformations. In dimethylformamide, above the pentamer the trend for the b_0 values approached those for the helical high polymer. From these data it was concluded that folded or partially folded forms exist for benzyloxycarbonyl-blocked oligomeric peptides derived from α -esters of L-glutamic acid in helix-forming solvents at the penta- and larger peptides. An enhancement of helical properties is observed above the nonapeptide, which is most probably due to the strengthening of the helix structure through bifunctionally intramolecularly hydrogen bonded residues. From infrared and molecular weight studies in dioxane, it appears that the penta- and larger peptides exhibit association; a fact which, in conjunction with optical rotation data, leads to the postulation of an additional structure, the associated folded form.

Another aspect of this work has been to examine the stability of the helix conformation of oligomeric peptides at and above the critical size. We have shown that the existence and stability of these conformations are governed both by the solvent in which the peptide is dissolved and by the temperature. We have examined some of the optical rotational properties of oligomeric peptides in dimethylformamide between 0 and 70°. Although the temperature dependence of helix formation has been observed, no thermodynamic treatment can be applied because complete transitions from random coil to helix were not observed. Microfilm \$2.75; Xerox \$7.40. 158 pages.

THE BASICITIES OF ETHERS AND PHENOLS

(Order No. 61-3290)

Ching-Yong Wu, Ph.D.
 University of Pittsburgh, 1961

Supervisor: Edward M. Arnett

The basicity constants of organic oxygen compounds have not been determined previously and the question of how analogous compounds of nitrogen, oxygen, phosphorus, and sulfur will differ in their abilities to accept a proton in aqueous acid solution has never been answered.

By means of a modified Hammett indicator method the pK_a 's of the oxonium ions for the following phenols and phenyl ethers have been determined in aqueous sulfuric acid: phenol, hydroquinone, p-bromophenol, p-t-butylphenol, 2,6-dimethylphenol, anisole, phenetole, n-propyl phenyl ether, i-propyl phenyl ether, n-butyl phenyl ether, i-butyl phenyl ether, s-butyl phenyl ether, n-amyl phenyl ether, p-dimethoxybenzene, coumaran, chroman, and 5,5-dimethylhomochroman. Both 2,6-dimethylanisole and cyclohexyl phenyl ether are too insoluble to investigate and t-butyl phenyl ether is too unstable. Since most of the phenolic compounds are readily decomposed in the strong

sulfuric acid media which are required to protonate these weak bases, the spectrophotometric measurements were made at 0° and a special treatment of the data has been developed to deal with sulfonation and solvent effects.

Our results show that these phenolic compounds are protonated on the oxygen rather than the ring and are in general more sensitive to stereoelectronic effects than are their nitrogen analogs. A very large effect of steric inhibition of resonance has been observed for 5,5-dimethylhomochroman. This ether is 4.60 pK_a units more basic than anisole.

The pK_a values for the conjugate acids of many important simple ethers have also been estimated employing solvent extraction and gas chromatography. These ethers are: dimethyl ether, methyl ethyl ether, methyl n-propyl ether, methyl i-propyl ether, methyl n-butyl ether, methyl t-butyl ether, diethyl ether, ethyl n-butyl ether, ethyl t-butyl ether, di-n-propyl ether, diisopropyl ether, di-n-butyl ether, 1,2-dimethoxyethane, dioxane, tetrahydrofuran, tetrahydropyran, hexamethyleneoxide, and 2-methyltetrahydrofuran.

The validity of the technique was thoroughly investigated by a large number of critical tests. The results not only confirm the superior basicity of cyclic ethers over acyclic ethers but also clearly demonstrate the failure of the basicities of ethers to correlate with the basicity order of the corresponding amines in aqueous acid solution. Evidence is presented which indicates that the basicity of oxygen bases is controlled by a complex balance of inductive, steric, and solvation forces. Our results for alicyclic ethers provide another example of Brown's "I-strain" order.

The results are in good agreement, in general, with the order of relative basic strength estimated by other means of basicity measurements; such as Gordy's method of measuring the infrared frequency shift of the H-X stretching band of hydrogen-bond donors when dissolved in organic base, the solubility of gaseous hydrogen halide in organic base, and the relative stability of molecular addition compounds with various Lewis acids.

These techniques and treatments may be applicable to many other classes of weak bases currently under study but probably should be applied with great caution to unexplored classes of compounds.

Microfilm \$2.80; Xerox \$9.70. 213 pages.

CHEMISTRY, PHARMACEUTICAL

PODOPHYLLUM COMPONENTS: SYNTHETIC APPROACHES.

(Order No. 61-3150)

Philip Salvatore Portoghesi, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Edward E. Smissman

1. A general synthetic approach to podophyllum lignans which are stereochemically related to podophyllotoxin was investigated.

2. An attempt at kinetically controlled C₃ epimerization of 3-carbomethoxy-4-phenyltetralin was unsuccessful.

3. The stereochemistry of the products obtained by the Stobbe condensation of 3,4-methylenedioxy-3',4',5'-trimethoxybenzophenone with dimethylsuccinate and the dihydro-Stobbe products is proved. The conformational implications derived by a study of the cyclization of the dihydro-Stobbe products are discussed.

4. Reduction of 3-carbomethoxy-4-(3',4',5'-trimethoxyphenyl)-6,7-methylenedioxy-1-tetralone with sodium borohydride produced 3-carbomethoxy-4-(3',4',5'-trimethoxyphenyl)-6,7-methylenedioxy-1-tetralol, which when converted to the corresponding acid, underwent lactonization in acetic anhydride.

5. The conversion of 3-carboxy-4-(3',4',5'-trimethoxyphenyl)-6,7-methylenedioxy-1-tetralol to 1-(3',4',5'-trimethoxyphenyl)-2-carboxyl-1,2-dihydronaphthalene was effected by heating at a temperature of 195° for eight minutes.

6. The cyclic formal of 1-hydroxy-2-hydroxymethylene-6-methoxytetralin was formed in the absence of mineral acid catalyst when 7-methoxy-1,2-dihydronaphthalene in glacial acetic acid was treated with formaldehyde at a temperature of 90°.

7. The nonstereospecificity of the Prins reaction with anethole was demonstrated by the isolation of two crystalline diastereomers of 1-phenyl-2-methyl-1,3-propanediol diacetate.

8. Reaction of the diastereomers of 1-phenyl-2-methyl-1,3-propanediol with aqueous formaldehyde in the absence of acid catalyst, produced 4-phenyl-4-methyl-1,3-dioxane. The infrared spectra of the dioxanes resulting from the diastereomeric glycols were virtually superimposable but not identical.

Microfilm \$2.75; Xerox \$3.80. 68 pages.

DERIVATIVES OF 2-QUINOLINE ACRYLIC ACID AS POTENTIAL ANTIINFECTIVE AGENTS (Order No. 61-3177)

Madhukar Gopal Vaidya, Ph.D.
The University of Wisconsin, 1961

Supervisor: Associate Professor Joseph G. Cannon

The fused tricyclic system hexahydro benzo-[a]-pyridocoline present in emetine has been shown by earlier investigation to possess activity against *Entamoeba histolytica*. The project undertaken in this laboratory was the preparation of the closely related ring systems hexahydro benzo-[e]-pyrrocoline and hexahydro benzo-[c]-pyridocoline with substituents on the benzene ring analogous to those present in another group of antiamebic agents, halogenated 8-quinolinols. Thus two different pharmacophoric moieties would be combined into one molecule.

The first phase in the over-all problem was the preparation of 2-quinoline acrylic acids as intermediates in synthesis of the desired ring systems. Methods were devised for the preparation of 8-hydroxy- and 8-alkoxy-; 5-chloro-8-ethoxy; 5,7-dihalo-8-hydroxy and 8-alkoxy-2-quinoline acrylic acids.

The starting points in the synthesis of the acrylic acids were appropriately substituted quinaldines, which were prepared from 8-hydroxy quinaldine or by a Doebner von Miller cyclization. The quinaldines were condensed with chloral and the resulting products were treated with ethanolic potassium hydroxide to form the 2-quinoline acrylic acids.

Some quinaldines failed to react with chloral; these were oxidized to quinaldaldehydes with selenium dioxide, and the quinaldaldehydes were subjected to the Doebner modification of the Knoevenagel reaction forming the corresponding acrylic acids. This application of the Knoevenagel reaction represented a heretofore unreported method of preparation of 2-quinoline acrylic acids.

Preliminary biological investigation indicated that 2-quinoline acrylic acids had slight antibacterial activity; their ethyl esters had a marked antifungal activity. 8-Ethoxy- and 5,7-dichloro-8-ethoxy-2-quinoline acrylic acids exhibited *in vitro* amebicidal activity comparable to that of 5-chloro-7-iodo-8-quinolinol (Vioform).

Microfilm \$2.75; Xerox \$4.80. 91 pages.

PART I. CONFORMATIONAL ANALYSIS OF THE PRINS REACTION.

PART II. AN INVESTIGATION OF PLANT RESISTANCE FACTORS FROM ALFALFA.

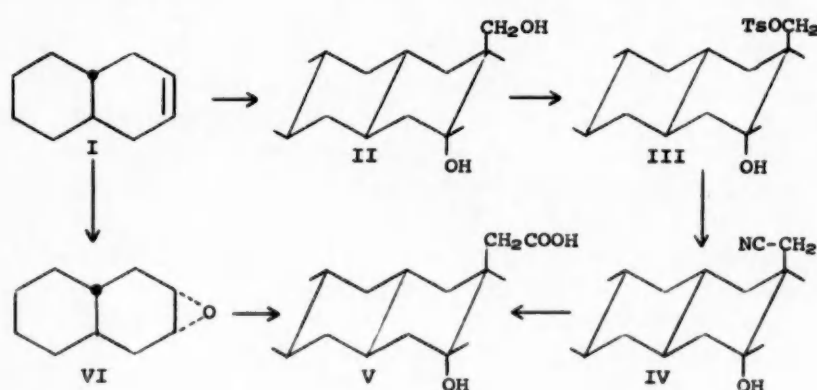
(Order No. 61-3179)

Donald Theodore Witiak, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Edward E. Smissman

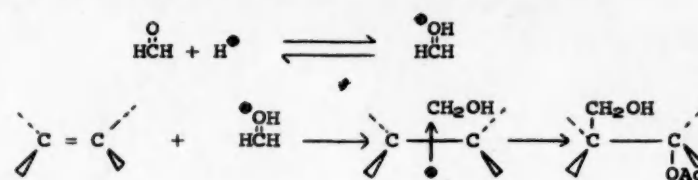
I

The Prins reaction can be defined as the acid catalyzed reaction of formaldehyde with olefins to yield 1,3-glycols, m-dioxanes, and other related compounds. This thesis describes the mechanism and stereochemistry of the Prins reaction in terms of a conformational analysis of one of the reaction products when *trans*- Δ^2 -octalin (I) is employed as the olefin. When *trans*- Δ^2 -octalin (I) was subjected to the conditions of the Prins reaction *trans*-3(a)-hydroxymethyl-2(a)-hydroxy-*trans*-decalin (II) was proved to be one of the products. That II had the diaxial conformation was proved in the following manner: The monotosylate (III) of II was prepared and subsequently displaced with cyanide ion. The nitrile (IV) was subjected to alkaline hydrolysis and yielded a hydroxy acid (V). The acid was identical in all properties with one prepared by Johnson,



et al (J. Am. Chem. Soc., 83, 606 (1961)) through opening of the 2,3-epoxy-*trans*-decalin (VI) with the anion of malonic ester followed by hydrolysis and *mono*-decarboxylation.

On the basis of results of other workers and work done in this laboratory it appears that the mechanism of formation of the 1,3-diol entails the following steps:



II

This thesis describes the work thus far completed on the isolation of plant resistance factors from alfalfa.

1. Biological assays of the aqueous extracts of the alfalfa varieties, Vernal, Turkestan, and Lahontan indicate that plant resistance can not be determined utilizing only the crude extracts. Clearly, isolation of pure compounds will be necessary before a correlation of growth inhibition of *Penicillium* to plant resistance can be made.

2. An uncharacterized substance, appearing to be an aliphatic amide but believed to be an artifact, was shown to exhibit 28% inhibition of growth of *Penicillium* when three milligrams of the crude material was employed in the assay.

3. The biologically inactive ester, bis-(2-ethylhexyl)-phthalate was isolated from alfalfa but is believed to be an impurity.

4. The flavone, tricin (5,7,4'-trihydroxy-3',5'-dimethoxyflavone), was isolated from a highly active fraction. The flavone was shown to exhibit no growth inhibitory effects against *Penicillium*.

5. Two isolation procedures are presented which give rise to salicylic acid. This compound exhibits mild growth inhibition of *Penicillium*.

6. An isolation procedure for a highly active, viscous, yellow oil is presented. On the basis of physical properties the oil appears to be a hydroxy, unsaturated aromatic carboxylic acid.

Microfilm \$2.75; Xerox \$3.80. 70 pages.

CHEMISTRY, PHYSICAL

PHYSICOCHEMICAL PROPERTIES OF CONCENTRATED SOLUTIONS OF SODIUM THIOCYANATE IN LIQUID AMMONIA

(Order No. 61-3625)

George Constantin Blytas, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Farrington Daniels

The theoretical interest of concentrated electrolytic non-aqueous solutions, and the practical importance of concentrated solutions of electrolytes in liquid ammonia

have led to the present investigation of properties of concentrated solutions of sodium thiocyanate in liquid ammonia.

The complete phase diagram of sodium thiocyanate and sodium nitrate, and the solubilities of a large number of salts were determined. Densities, vapor pressures, viscosities, thermal conductivities, heats of solution, and heat capacities of sodium thiocyanate-ammonia solutions were determined. Possible explanations of the trends and magnitudes observed were given.

In the course of this work a simple technique for obtaining freezing points and densities of liquid ammonia solutions was developed. Special apparatus for studying each of the other properties enumerated above were also designed and built.

Finally, the possibility of using sodium-thiocyanate ammonia solutions in solar refrigeration cycles, and the potentialities of lithium nitrate and ammonium nitrate in the fields of rocket propulsion and power generation were discussed. Microfilm \$2.75; Xerox \$8.40. 185 pages.

THE VIBRATIONAL SPECTRA AND
MOLECULAR STRUCTURES OF
SOME INORGANIC COMPOUNDS:
ReO₃Cl, ReO₃Br, Si(NCO)₄, AND Ge(NCO)₄.

(Order No. 61-3255)

Gerald Leroy Carlson, Ph.D.
University of Pittsburgh, 1961

Supervisor: Foil Miller

The vibrational spectra of four covalent inorganic compounds have been studied for the purpose of determining their molecular geometries and fundamental vibrational frequencies. The substances investigated are (a) rhenium oxychloride, ReO₃Cl, (b) rhenium oxybromide, ReO₃Br, (c) silicon tetrakisocyanate, Si(NCO)₄, and (d) germanium tetrakisocyanate, Ge(NCO)₄.

ReO₃Cl is a pale yellow, light-sensitive liquid. Its complete Raman spectrum with polarization measurements and its infrared spectrum over the range 195-3000 cm⁻¹ were obtained. The fundamentals have been assigned for C_{3v} symmetry as: species a₁ = 293, 435, and 1001 cm⁻¹; species e = 196, 344, and 960 cm⁻¹. Using these frequencies the thermodynamic properties have been calculated at five temperatures. The ultraviolet absorption spectrum of ReO₃Cl vapor was also obtained and was found to consist of a single band at 2025 Å, and a series of twelve bands extending from 2350 to 2850 Å.

ReO₃Br is a white solid which melts at 38°C. A new, although not very satisfactory, method of preparation involving the bromination of rhenium(VI)oxide was used. The infrared spectrum was obtained over the range 100-3000 cm⁻¹. The fundamentals for C_{3v} symmetry are: a₁ = 195, 350, and 997 cm⁻¹; e = 168, 332, and 963 cm⁻¹. The ultraviolet absorption spectrum of a methylene chloride solution of ReO₃Br was also obtained. It is quite similar to that of ReO₃Cl.

Si(NCO)₄ and Ge(NCO)₄ are both colorless liquids. Complete Raman spectra with polarizations and infrared spectra over the range 100-4000 cm⁻¹ were obtained for

both compounds. Consideration of group frequencies showed that both are the tetrakisocyanates and not the tetracyanates. The vibrational spectra of the two compounds are extremely simple and quite similar, but differences are profound enough to imply that their structures are different. The logical model for Si(NCO)₄ would be one in which the four nitrogens are arranged tetrahedrally around the central silicon with a kinking of each Si-N=C=O group at the nitrogen atom. (HNCO and its derivatives are known to be bent at an angle of about 125°.) However any model of this type predicts a spectrum greatly different from that observed. The best agreement between prediction and observation is obtained for the truly tetrahedral model, and it is concluded that Si(NCO)₄ has T_d symmetry with linear Si-N=C=O groups. The straightening of the Si-N-CO skeleton is explained by postulating that the unshared pair of electrons on nitrogen are bonding to silicon through the available 3d orbitals of the latter. The use of 3d orbitals of silicon to provide additional bonding has been described by other workers, but Si(NCO)₄ is the first case where four groups attached to silicon are involved in this "extra" bonding.

The major difference between the spectra of Ge(NCO)₄ and Si(NCO)₄ is that Ge(NCO)₄ shows an extra polarized Raman line which is also active in the infrared. This band, along with other evidence, is taken as showing quite definitely that the structures of the two molecules are different. However there is no reasonable model which will explain the spectrum of Ge(NCO)₄, and one is forced to conclude that it has approximately tetrahedral symmetry, the deviation being due to some kinking of the Ge-N=C=O groups.

An x-ray diffraction study was undertaken to confirm the conclusions concerning Si(NCO)₄ and Ge(NCO)₄. Si(NCO)₄ was found to crystallize in the triclinic system with four molecules per unit cell. This showed that a complete structure determination would be a formidable problem and the study was abandoned. No x-ray results could be obtained for Ge(NCO)₄. In addition the carbon-13 n-m-r spectra and the ultraviolet absorption spectra of both compounds were measured, and several unsuccessful attempts were made to prepare Sn(NCO)₄ and Ti(NCO)₄.

Microfilm \$2.75; Xerox \$3.00. 55 pages.

REACTIONS OF IODINE AND IODIDE IONS
IN THE PRESENCE AND ABSENCE
OF POLYSACCHARIDES

(Order No. 61-3033)

John Albert Effenberger, Ph.D.
Iowa State University of Science and Technology, 1961

Supervisor: Dexter French

The markedly increased solubility of iodine in aqueous solutions due to the presence of iodide ion has been systematically studied over a wide range of I₂ and KI concentrations at 25°C. The extent to which various types of polyiodide ions contribute to this increased solubility has been determined by a statistical treatment of the data. Estimates of the formation constants, K_{2n+m}, of polyiodides of the type, I_{2n+m}^{-m} were obtained. These formation

constants are related to the polyiodide formation function, Φ , and thus to experimentally determinable quantities by the following equation.

$$\Phi = (I_2)_b / (I_2)(I^-) = \sum_n \sum_m n K_{2n+m} (I_2)^{n-1} (I^-)^{m-1}$$

where, $(I_2)_b$ = the molar concentration of complexed I_2

(I^-) = the molar concentration of I^-

(I_2) = the molar concentration of free I_2

n = the number of I_2 molecules in the complex

m = the number of I^- ions in the complex

The molar concentration of bound or complexed I_2 was found by difference from the total and free I_2 concentrations. The total I_2 concentration was found by direct titration, and the free I_2 concentration by means of the well known distribution technique. A CCl_4 phase was used as a reference phase and suitable values for the distribution coefficient of I_2 between CCl_4 and a salt solution of ionic strength 2.00 determined as a function of I_2 concentration.

The I^- concentration was obtained potentiometrically by means of a concentration cell. The reference half-cell contained a known concentration of I_2 and I^- . The total iodide concentration was varied between .05 M and 1.0 M in these studies, and the entire solubility range of I_2 in these solutions was covered. All solutions were adjusted to an ionic strength of 2.00 by the addition of KNO_3 as a diluent salt.

By means of a statistical analysis of Φ as a function of (I_2) and (I^-) , it was possible to obtain estimates of the formation constants for the various possible polyiodides and to determine whether or not they were significantly different from zero. It was concluded from these experiments that ions such as I_5^- , I_7^- , and I_9^- , although known in the solid state, do not appear to exist to any appreciable extent in aqueous solutions. However, ions such as I_4^- , I_6^- , I_8^- , and I_9^{3-} do form to a measurable degree. Most of the dissolved iodine exists as I_3^- or its polymers, I_6^- and I_9^{3-} . The equilibrium constants for the formation of these ions are:

$$K_3 = (I_3^-)/(I_2)(I^-) = 745.0$$

$$K_4 = (I_4^-)/(I_2)(I^-)^2 = 137.4$$

$$K_6 = (I_6^-)/(I_2)^2(I^-)^2 = 1.934 \times 10^5$$

$$K_8 = (I_8^-)/(I_2)^3(I^-)^2 = 1.621 \times 10^8$$

$$K_9 = (I_9^{3-})/(I_2)^3(I^-)^3 = 7.359 \times 10^8$$

Independent evidence for the formation of I_4^- from I_3^- and I^- was obtained from a spectrophotometric examination of solutions in which relatively large amounts of I_4^- might be expected to occur. The equilibrium constant, 0.107, obtained from the spectrophotometric data for the formation of I_4^- from I_3^- and I^- agrees well with that obtained in the statistical treatment.

Spectrophotometric examination of starch- I_2 - I^- complexes separated electrophoretically on a hanging curtain indicate that the polyiodine cores in these complexes are quite different from the polyiodide ions in aqueous solutions. Microfilm \$2.75; Xerox \$5.80. 116 pages.

SOLID STATE POLYMERIZATION OF CRYSTALLINE ACRYLAMIDE

(Order No. Mic 61-1045)

Thomas Alan Fadner, Ph.D.
Polytechnic Institute of Brooklyn, 1961

Adviser: Herbert Morawetz

Previous studies of solid state polymerization left largely unresolved the questions of the reaction mechanism and of the role played by the crystal lattice. In this thesis, it was attempted to clarify these problems by using experimental conditions which separate clearly chain initiation and chain growth. The reaction kinetics and the chain length of the polymer were then studied as a function of experimental conditions.

Acrylamide crystals, subjected to a 16-fold range of Co^{60} -radiation doses at $-78^\circ C$ (at which temperature no polymerization takes place), and subsequently kept at temperatures ranging from 0° to $60^\circ C$, will polymerize for many months. The polymerization rate, initially many orders of magnitude smaller than that in the liquid state, decreases sharply with polymerization time at low degrees of conversion. At constant temperature, the polymer chain length is independent of irradiation dose and depends only on polymerization time; at constant dose, it is a function of the polymer yield and independent of the polymerization temperature. The ratio of polymer yield and molecular weight increases only slightly during the polymerization. These observations indicate independent growth of the polymer chains, whose total number remains nearly independent of polymerization time.

Propionamide is isomorphous with acrylamide and forms solid solutions over the entire composition range. The polymerization rate in propionamide/acrylamide solid solutions is almost independent of propionamide concentration up to 20%, but the polymer chain length is cut drastically with increasing propionamide content. This behavior shows that propionamide acts as a surprisingly efficient chain transfer agent, indicating a significant lattice control of the propagation reaction. This interpretation is substantiated by the observation that partial destruction of the acrylamide crystal lattice by inclusion of non-isomorphous acetamide increases both the polymerization rate and polymer chain length.

The decrease in polymerization rate with time is not caused by gradual destruction of the crystal lattice due to polymer formation, but seems to be a function of the kinetic chain length. The results indicate that neither termination by entrapment of active chain ends nor initiation of new chains during post-polymerization, for instance by release of previously trapped radicals, can be considered predominant processes in the over-all reaction.

The kinetics and molecular weight data are consistent with bimolecular termination wherein growth is limited to isolated tracks produced by the irradiation. Since the number of radicals as estimated by electron spin resonance does not change appreciably during the polymerization, the termination would have to involve ionic chain ends. However, any mechanism involving bimolecular chain termination would lead to increasing polydispersity of chain lengths at long polymerization times and no such broad distribution of molecular weights were indicated by light scattering data. Crystallographic investigations show

that partially polymerized crystals contained distinct crystalline and amorphous regions. Since there are also numerous indications of the importance of the crystal lattice in solid state polymerization, the process may be pictured as involving lattice controlled propagation at the crystal/polymer interface, in which only active ends of the polymer chains are incorporated in the lattice.

Microfilm \$2.75; Xerox \$8.40. 183 pages.

ENERGY LEVELS OF PLATINUM(II) COMPLEXES ON THE BASIS OF LIGAND FIELD THEORY

(Order No. 61-3034)

Richard Ferdinand Fenske, Ph.D.

Iowa State University of Science and Technology, 1961

Supervisor: Don S. Martin

The energy levels of square-planar platinum(II) complexes were calculated on the basis of ligand field theory in which a point dipole model was used for the ligands. Configuration interaction, including spin-orbit coupling, was taken into account by the appropriate choice of basis functions for the irreducible representations of the D_{4h} group. The resultant secular equations, derived for both the weak and strong field cases, were solved numerically by means of a high speed digital computer. Reasonable values for the ligand field, electronic interaction, and spin-orbit coupling parameters were chosen to obtain theoretical transition energies for $PtCl_4^{2-}$ and ammonia-substituted chloroplatinates(II) which gave good agreement with experimental values taken from absorption spectra. D_{4h} symmetry was assumed for all the complexes considered in order to simplify the calculations.

The proposed energy level assignment for the d-orbitals is: $d_{x^2-y^2} > d_{xy} > d_{z^2} > d_{xz}, d_{yz}$, which differs from an assignment previously reported in the literature in regard to the order of the d_{z^2} orbital and the degenerate d_{xz}, d_{yz} orbitals.

The thesis includes four appendices which present detailed notes on all pertinent derivations of the appropriate wave functions and matrix elements. This is meant to serve as a guide to future workers in the field.

Microfilm \$3.20; Xerox \$11.25. 248 pages.

A COMPARATIVE STUDY OF THE PYROLYSIS OF VINYLACETYLENE, DIACETYLENE, AND ALLENE.

(Order No. Mic 61-2542)

Jerry Dan Frazee, Ph.D.

The University of Texas, 1959

Supervisor: Dr. Robbin C. Anderson

A study has been made of the pyrolysis of vinylacetylene, diacetylene, and allene. Vinylacetylene [22 mole percent at 600 cc/min.] was found to be quite reactive even at moderate temperatures [500 °C.]. The principal vapor

products are hydrogen, methane, ethylene, acetylene, and benzene. Vinylacetylene reacts extensively with acetylene, with the result that the production of hydrogen, methane, and carbon are accelerated. It is suggested that vinylacetylene is an important intermediate in the acetylene pyrolysis reaction, particularly between 500-700 °C.

Small concentrations of diacetylene [2 mole percent] gave mostly carbon with vinylacetylene, hydrogen, and acetylene as the gas products. The limited results do not permit a clear interpretation of the method of reaction. Diacetylene enhances the acetylene reaction and may be an important intermediate in acetylene pyrolysis, particularly at higher temperatures [above 700 °C.].

The principal reaction of allene [22 mole percent] below 600 °C. is polymerization. It would be useful to establish the structure of these polymers in order to determine if the vapor products can be fully accounted for by the decomposition of polymers. At high temperatures [800 °C.], decomposition reactions are important. The principal gas products are methane and hydrogen with lesser amounts of ethylene, benzene, and propyne.

Microfilm \$2.75; Xerox \$5.20. 103 pages.

THE OXIDATION OF DIBORANE

(Order No. Mic 61-2168)

Marvin S. Goldstein, Ph.D.

Rensselaer Polytechnic Institute, 1960

Supervisor: Walter H. Bauer

A slow reaction between diborane and oxygen has been discovered at temperatures and pressures close to those which describe the second explosion limit for this system. The kinetics of the reaction have been investigated from 120° to 170°C and between 60 and 100 mm Hg total pressure.

Two different techniques have been used to study the reaction kinetics. According to one method, the reaction was monitored by the change in infrared absorption of a heated, reacting mixture. According to a second method completely sealed, all glass reaction bulbs were used to contain the mixtures. These were heated for a given time, then quenched in liquid nitrogen, and finally broken open and the contents were analyzed.

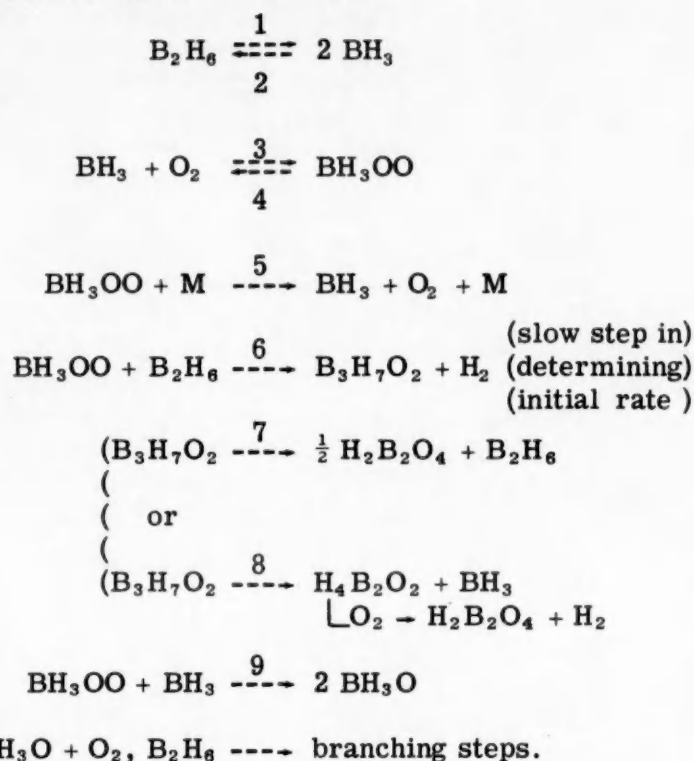
The explosive reaction between diborane and oxygen at the second explosion limit has been explained by a branching chain process. The slow reaction studied in this investigation has been shown to proceed according to the requirements of a degenerate chain branching process. The initial rate of this reaction, before it begins to accelerate, is 3/2 order with respect to the concentration of diborane and independent of the oxygen concentration. The apparent energy of activation, from the temperature coefficient of the initial rate, is 35 kcal mole⁻¹.

An unstable partial oxidation product was formed during the course of the slow reaction between diborane and oxygen. It was identified by means of its infrared absorption spectrum as the same partial oxidation product which had previously been discovered in the nonexplosive oxidation of pentaborane. Some hydrolysis experiments were carried out in attempts to further identify this compound.

The equation best fitting the over-all stoichiometry of the reaction is:



A reaction mechanism, consistent with all the above facts, has been proposed as follows:



During the course of the investigation of the slow reaction in Pyrex bulbs, several mixture preparations exploded. Whenever possible the products of these mixtures were also analyzed. These analyses indicated that in the explosive reaction, diborane was stripped of its hydrogen and then the species in the system reacted successively with oxygen. The relative rates at which these species reacted with oxygen decreased in the order, boron suboxide > boron > hydrogen.

Microfilm \$2.75; Xerox \$6.40. 133 pages.

THE OXIDATION OF PENTABORANE

(Order No. Mic 61-2169)

James A. Hammond, Ph.D.

Rensselaer Polytechnic Institute, 1958

Supervisor: Walter H. Bauer

A study was made of the oxidation of pentaborane, including the explosive reaction, the reaction which occurred when oxygen was slowly added to pentaborane, and the reaction which occurred when pentaborane was slowly added to oxygen.

Mixtures of oxygen and pentaborane, stable at room temperature, were prepared by slow vaporization of pentaborane into oxygen at known pressures at low temperatures, or were prepared by slow addition of pentaborane through a microcapillary to a measured amount of oxygen. The ignition temperatures of the mixtures were determined by heating at successively higher temperatures until explosion resulted. The resulting explosion limit

curves indicated the possibility of branched chain mechanisms, and the presence of a region of slow reaction. When the ratio of oxygen to pentaborane was increased, second limit ignition temperatures were increased at comparable total pressures showing that the termolecular chain-breaking efficiency of oxygen was greater than that of pentaborane. Reduction of the temperature required to ignite a mixture when the explosion vessels were coated with explosion products indicated that the chain-breaking efficiency of the wall was decreased by the presence of explosion products, or that the reaction was promoted by the explosion products. The primary products of the explosive reaction were B, B₂O₃ and water, followed by hydrolysis to H₃BO₃. An intense blue luminosity was observed in pentaborane-oxygen mixtures when the pressure was reduced to less than five millimeters of mercury.

When oxygen was slowly added to pentaborane, at rates which varied between 10⁻⁶ and 10⁻⁹ moles of oxygen per hour, a reaction occurred which resulted in the formation of diborane, hydrogen, boric oxide and a relatively unstable gaseous compound. On faster addition of oxygen to pentaborane, at a rate of 10⁻³ moles of oxygen per hour, explosion occurred within five minutes. The solid oxide formed in the partial oxidation was identified as B₂O₃. Small quantities of higher hydrides present in a large quantity of the solid were detected by infrared absorption. The intermediate gaseous compound formed was found to have a molecular weight of 72.06, and to contain boron, hydrogen and oxygen. Analysis of a hydrolyzed sample of the compound showed the presence of four boron atoms per molecule. An empirical formula of B₄H₁₂O was established, based on infrared absorption measurements, mass spectrometry, and studies of isotopically enriched derivatives.

When pentaborane was slowly added to oxygen at low temperature, no reaction was detected in a wide range of pressures and composition ratios for periods as long as fifty hours. At sufficiently high temperatures and pressures explosion occurred. A composition limit of explosion was determined for pentaborane-oxygen mixtures at 22.0 degrees centigrade.

The region of slow reaction, the complex explosion limit curve, the reaction which occurred on slow addition of oxygen to pentaborane, and the absence of reaction until explosion occurred when pentaborane was slowly added to oxygen are discussed with reference to a proposed oxidation mechanism.

Microfilm \$2.75; Xerox \$7.40. 160 pages.

STUDIES ON THE PHOSPHORESCENCE OF POLYSTYRENE

(Order No. Mic 61-1570)

Lucia Pozzi-Escot Herold, Ph.D.

Fordham University, 1961

Mentor: Rev. Clarence C. Schubert, S.J.

A bluish green phosphorescence was obtained when a thin film of polystyrene was subjected to an electrical discharge in a helium gas medium at liquid air temperature. The glow and afterglow thus produced were received

on a selenium photo cell connected to a recorder so that the amount of luminescence radiated by the phosphor was recorded as a function of time.

It was found that the pressure of the gas carrier in the flask affected the deactivation process. The optimum pressure was ca. 4×10^{-2} mm. of Hg. At higher pressures the gas itself started to flow while the polystyrene glow diminished. At a lower pressure there was no visible effect in either. Runs conducted at -196° , -78° , 0° , and 25° C., indicated that the intensity of the phosphorescence decreased with rise in temperature. In general, no noticeable effect was observed when the thickness of the polystyrene film was changed, although when extremely thin films were employed, a slight dependence on polystyrene concentration was found. Changing the solvent used to form the film or the nature of the gas in which the film was placed, was without effect either on the intensity or the color of the phosphorescence. When polystyrene films containing small additions of either anthracene or methyl-2-anthryl ketone were irradiated, the fluorescence of the two mixtures and phosphorescence of the latter appeared blue rather than light green. The inclusion of other impurities caused no change in the color of the radiation.

It was assumed that the rate of deactivation of the activated molecule was directly proportional to the intensity of the light emitted; and it was found that this light was directly proportional to the millivolts observed on the recorder. In mathematical form this is:

$$I = -k \frac{d\phi^*}{dt} \quad (I)$$

and

$$MV = k' I. \quad (II)$$

where I = luminosity, ϕ^* = activated substance, MV = millivolts, k and k' = constants and α = order dependence on concentration of ϕ^* .

On combining these two equations with the kinetic equation

$$-\frac{d\phi^*}{dt} = k'' [\phi^*], \quad (III)$$

it was found that the kinetics of the decay process of the phosphorescence appeared to be one-half order with respect to the concentration of the activated species. There was observed an approximately zero energy of deactivation.

Polystyrene made in the laboratory without catalyst or copolymer, showed the same green phosphorescence as did the commercial polymer when subjected to the same experimental treatment. On the other hand, benzene, styrene and liquid butadiene, when frozen in a matrix of dioxane, showed no phosphorescence whatsoever when treated in a similar manner.

The visible emission spectrum of the polystyrene glow and afterglow, taken by means of a Gaertner Spectrograph, showed a line at 4855 Å. and a weaker one at 4340 Å.

An explanation is suggested for these experimental observations based on the supposition that the observed phosphorescence may be due to the decay of polystyrene diradicals. Microfilm \$2.75; Xerox \$3.80. 66 pages.

THE CRYSTAL STRUCTURE OF BISMUTH MONOCHLORIDE

(Order No. 61-3037)

Alexander Hershaft, Ph.D.

Iowa State University of Science and Technology, 1961

Supervisor: John D. Corbett

Bismuth monochloride* separates out as a solid phase when bismuth metal is dissolved in liquid BiCl_3 . Its crystals take the form of black diamagnetic needles with a flattened hexagonal cross section. The crystal structure of bismuth monochloride was determined as an aid in the identification of the species formed in the Bi-BiCl_3 system.

The stoichiometric formula of bismuth monochloride was found to be $\text{BiCl}_{1.17}$. The crystals are orthorhombic with lattice constants $a_0 = 23.057$, $b_0 = 15.040$ Å, $c_0 = 8.761$ Å and space group Pnnm . The experimental density of 6.54 g/cc agrees well with the 6.56 g/cc value calculated on the basis of the 48 Bi and 56 Cl atoms per unit cell. Three-dimensional Weissenberg and precession film data were obtained with $\text{Cu K}\alpha$ radiation. The 2500 reflections were judged visually, and corrected for the Lorentz factor, polarization, absorption, and multiplicity.

The structure was determined by the heavy atom technique. Interpretation of a three-dimensional Patterson map located all 48 Bi positions and thus established the phases of the more important reflections. The 56 Cl positions were found through three-dimensional Fourier and difference Fourier maps. Refinement of the structure was carried out by the least squares technique using isotropic temperature factors. All positions refined satisfactorily resulting in a final R_1 value of 0.156.

Each unit cell contains four Bi_9^{+5} cations in the shape of distorted trigonal prisms that have a Bi atom projecting from each face. There are also eight BiCl_5^- and two Bi_2Cl_8^- anions where the Cl atoms assume a distorted tetragonal pyramidal configuration about Bi. The cation has delocalized bonding and a charge of +5 based on the assignment of Bi(III) atoms to the anions. The latter are thought to have conventional Bi-Cl bonds. Intermolecular linkage is provided by weak Bi-Cl interactions which are considerably shorter between anions than between an anion and the cation. They are responsible for the configurational distortions. A mode of structural breakdown with rising temperature is proposed and the species formed by interaction of the fragments with the BiCl_3 solvent are compared with results of previous investigations.

*The term "bismuth monochloride" and the symbol BiCl will be used throughout this work for the sake of convenience to designate the compound whose crystallographic formula turns out to be $\text{BiCl}_{1.17}$.

Microfilm \$2.75; Xerox \$5.20. 102 pages.

THE MOLECULAR AND CRYSTAL STRUCTURES
OF PHOSPHINOBORANE AND
DIMETHYLSULFOXIDE-BORON TRIFLUORIDE

(Order No. Mic 61-713)

Edward Lewis McGandy, Ph.D.
Boston University Graduate School, 1961

Major Professor: Klaas Eriks

Crystals of phosphinoborane, $\text{PH}_3\text{:BH}_3$, have been studied by X-ray crystallographic methods. After synthesis of the compound in a vacuum line, single crystals were obtained in capillaries and precession photographs were taken. The space group is $R\bar{3}m$ and the trigonal unit cell contains three formula units and has the dimensions: $a = b = 7.363 \pm 0.024 \text{ \AA}$, and $c = 5.766 \pm 0.020 \text{ \AA}$. The dominance of a heavy atom at the origin of the unit cell led directly to the selection of a trial structural model in which the $\text{PH}_3\text{:BH}_3$ molecular axis was placed parallel to the c axis. Structure factor calculations for 33 $h0l$ reflections confirmed this model.

Refinement of the structural model was carried out first by means of $h0l$ difference fourier maps. Agreement between observed and calculated structure factors was then further improved by systematically adjusting the z -parameter of boron and the thermal motion parameters of boron and phosphorus. Hydrogen atom positions were found from a three-dimensional difference fourier map in which six maxima were found in both of the regions where three hydrogen atoms were expected. Rotational disorder in the crystal is indicated as the probable cause for the doubling of these peaks. Because of the disorder, the two possible hydrogen atom configurations, staggered and eclipsed, cannot be distinguished on the basis of X-ray evidence, but calculated intermolecular hydrogen-hydrogen distances show that the staggered configuration is very unlikely.

The phosphorus-boron bond length is found to be 1.93 \AA , the same as that in $(\text{CH}_3)_3\text{P:BH}_3$ and in $((\text{CH}_3)_2\text{P:BH}_2)_3$ within experimental error. The phosphorus-boron bond in $(\text{NH}_2)_3\text{P:BH}_3$ is considerably shorter than in the other compounds mentioned, but the longer bond length is the normal one and chemical explanations for the shorter bond in $(\text{NH}_2)_3\text{P:BH}_3$ are offered.

Crystallographic investigation was also made of dimethylsulfoxideboron trifluoride, $(\text{CH}_3)_2\text{SO:BF}_3$. Single crystals were sealed out of contact with moisture in glass capillaries and photographed on a precession camera. The space group is monoclinic, $P2_1/c$, and the unit cell dimensions are: $a = 6.058 \pm 0.005 \text{ \AA}$, $b = 9.893 \pm 0.020 \text{ \AA}$, $c = 11.244 \pm 0.015 \text{ \AA}$, and $\beta = 113.30 \pm 10^\circ$, with four formula weights of the compound per unit cell.

A three-dimensional Patterson function and a two-dimensional Patterson superposition led to a correct trial structure on the $0kl$ projection. The solution of the $h0l$ projection was effected by similar methods, and the three-dimensional trial structure was refined by differential synthesis, using the IBM 650 computer.

Dimethylsulfoxide is bonded to the BF_3 group by way of the oxygen atom, and the S-C bonds in the complex are shorter than those in the free molecule. The S-O bond length, 1.52 \AA , is greater in the complex, and the vertical angles at the sulfur atom in the complex are more acute. Moffitt's molecular orbital model for alkyl sulfoxides is

used to explain the S-O bond length and the changes in the vertical angles at the sulfur atom. The S-O-B angle, 119° , is compared with the 144° P-O-Sb angle in $\text{POCl}_3\text{:SbCl}_5$, and the O-B bond of 1.54 \AA is compared with 1.50 \AA found for a similar bond in $(\text{CH}_3)_2\text{O:BF}_3$. A correlation is found between changes in S-O bond length and the amount of pi bonding character in a number of sulfur-oxygen compounds. This relationship shows that the S-O bond in dimethylsulfoxide-boron trifluoride has a pi bond order of 0.60.

An integrating photometer for measuring the intensities of diffracted X-ray spots on single crystal photographs is described. The instrument operates on a new principle, and is simple in construction. Several new IBM 650 computer programs for crystallographic calculations have been written, and the method of operation of each program is given. Microfilm \$2.75; Xerox \$6.60. 138 pages.

MOLTEN SALTS. THE STRUCTURE
AND CONSTITUTION OF THE
MOLTEN MERCURIC HALIDES.

(Order No. Mic 61-2170)

James Douglass Edmondson McIntyre, Ph.D.
Rensselaer Polytechnic Institute, 1961

Supervisor: George J. Janz

Owing to its low shielding efficiency, the mercuric ion is characterized by a tendency to form molecular and complex ionic species with polarizable addends of low electron affinity. This thesis reports the results of an investigation of the molten state of the mercuric halides HgCl_2 , HgBr_2 and HgI_2 .

Densities, molar volumes and thermal expansion coefficients of the melts have been determined by a dilatometric method. Values found for the density of the pure chloride, bromide and iodide melts at their freezing points are, respectively: 4.359, 5.119 and 5.229 g. cm^{-3} . The corresponding molar volumes are 62.29, 70.41 and 86.92 $\text{cm}^3 \text{ mole}^{-1}$.

Viscosities of the volatile mercuric halides were measured by observation of the logarithmic decrement of the damping of sealed oscillating spheres containing the melts. For molten HgCl_2 , HgBr_2 and HgI_2 , the viscosities at the freezing point are 1.79, 2.38 and 2.96 cp., respectively. Activation energies for viscous flow are 3.45, 3.5 and 4.58 kcal. mole^{-1} .

Electrical conductivities of the poorly conducting melts were measured in sealed Pyrex cells. A new type of conductance bridge was employed for the measurements; its design and construction are described in detail. The molar conductivities at the freezing points are 0.00195, 0.00979 and 2.63 $\text{ohm}^{-1} \text{ cm}^2 \text{ mole}^{-1}$. For molten HgCl_2 and HgBr_2 , the corresponding activation energies for electrical conductance are 6-7 kcal. g. ion^{-1} . In contrast to ionic fused salts, these activation energies are greater than those for viscous flow and indicate the inclusion of a heat of ionization. Evidence for autocomplex ion formation in the melts is discussed. Degrees of dissociation estimated by an approximate method for the three halides at their freezing points are 3.5×10^{-5} , 2.3×10^{-4} and 7.8×10^{-2} , respectively.

Activation energies for electrical conductance in the solid state and the conductance changes on fusion have been determined qualitatively as well. Molten HgI_2 was found to exhibit a negative temperature coefficient of conductivity; the significance of this anomalous behavior is discussed in terms of an exothermic heat of ionization and electronic conduction.

Raman spectra of the pure HgCl_2 and HgBr_2 melts were obtained. For the chloride, lines at 313 (s) and 382 (vw) cm^{-1} were found. Lines at 206 (s) and 271 (vw) cm^{-1} were found for the bromide. These spectra indicate that the primary melt constituents are HgX_2 molecules with a linear configuration. The visible color changes which the mercuric halides undergo with phase change and increase of temperature are discussed with respect to the effect of environmental changes on their absorption spectra.

The mechanism and entropy of fusion of the mercuric halides are discussed in relation to their crystalline structure. The principal contribution to the entropy of fusion is shown to arise from increase of rotational freedom rather than positional randomization.

A model for the molten state of the mercuric halides is proposed in which the primary melt constituents are simple molecules, together with the complex ionic species HgX^+ and HgX_3^- at low concentration. Cohesive intermolecular forces are of the dispersion and multipole types, rather than the Coulombic forces predominant in ionic salt melts. The mechanisms of transport processes are discussed in relation to a hole model for the liquid state, assuming that Walden's rule is applicable to such covalent molecular melts.

Microfilm \$2.80; Xerox \$9.90. 216 pages.

ACTIVITIES AND ACTIVITY COEFFICIENTS OF ORGANIC BINARY MIXTURES

(Order No. Mic 61-2720)

Edward Neparko, Ph.D.
The University of Oklahoma, 1961

Major Professor: Dr. Sherril D. Christian

Two new methods have been developed for the determination of activities and activity coefficients of volatile binary mixtures. The first technique consists of measuring the total pressure above the solution and determining the composition of the liquid phase. By means of a suitable computer program, the partial pressures and activity coefficients can be evaluated for the components. In the second method, the total pressure and vapor density are determined, allowing the calculation of the partial pressures, activities, liquid composition and activity coefficients.

The total pressure method has been used in the study of two systems, acetic acid- CCl_4 and trifluoroacetic acid- CCl_4 at 10, 20 and 25 °C. Both systems show positive deviation from ideality, with the latter system forming an azeotrope. The total pressure curves for the systems were curve fitted using an IBM 650 computer. From these curves, the partial pressures and activity coefficients were calculated for the components by means of the Gibbs-Duhem equation. From the values of the activity coefficients

at the different temperatures, it appears that the heats of mixing are small for these systems.

The vapor density balance method has been applied to systems showing moderate positive deviation from ideality as in the case C_6H_6 - CCl_4 as well as to systems showing extreme positive deviation as in the cases C_6H_6 -methanol and CCl_4 -ethanol. For systems which deviate only moderately from ideality, comparison of the data obtained by the vapor density balance method with data from more elaborate methods shows that the vapor density balance method gives comparable accuracy. The activities were curve fitted by a computer program using a three constant equation involving a power series in the activity of one component, a_1 . The liquid phase composition and the activity coefficients were calculated as part of the same program using the Gibbs-Duhem equation.

Both the total pressure method and the vapor density balance method have been shown to be applicable to a wide variety of systems. The determination of partial pressures and hence, the activity coefficients from total pressure-liquid composition data is a very useful and accurate means of studying binary systems. Although sampling and analysis of the liquid phase is necessary, a system can be investigated over the whole concentration range in a day. The vapor density balance method has also been successfully applied to a number of systems and proved to be a simple and rapid method for determining activity coefficients of binary mixtures. A system can be studied in a day or less and there is no need for analysing the liquid phase.

The availability of these two techniques should prove to be important to the field of solution chemistry, since they provide accurate and rapid methods for gathering data on binary mixtures. At the present time, more data are needed on a wide variety of systems to further the development of a general theory of solutions.

Microfilm \$2.75; Xerox \$5.20. 102 pages.

AN EQUILIBRIUM DIALYSIS STUDY OF COMPLEX FORMATION BETWEEN CARBOXYPEPTIDASE A AND SOME AMINO ACIDS

(Order No. 61-3585)

Helmut Pessen, Ph.D.
Temple University, 1961

The background of protein binding studies is surveyed in relation to complex formation in general as well as with respect to enzyme kinetics and specificity. A variety of methods for studying binding is discussed and compared.

Preparatory to a study of binding of amino acids by carboxypeptidase A, the absorptivity of methyl orange at 465 $\text{m}\mu$ was redetermined as $(2.574 \pm 0.005) \times 10^4$ l./mole-cm, in 0.05 M phosphate buffer of pH 6.8. The specific refractive index increment over a concentration range from 10^{-3} M to 10^{-1} M at 589 $\text{m}\mu$ was determined for L-phenylalanine and DL- α -alanine in 0.1 M glycine - 2.0 M LiCl buffer at pH 7.5 as 0.2071 ± 0.0010 ml/gm and 0.1464 ± 0.0015 ml/gm, respectively; and in 0.05 M 2-amino-2-methyl-1, 3-propanediol buffer at pH 9.5 as 0.2133 ± 0.0012 ml/gm and 0.1663 ± 0.0013 ml/gm, respectively.

The problem of concentration anomalies in dialysis of solutes through cellulose tubing has been clarified. Previous reports of "negative" binding and the existence of different concentrations of solutes on either side of the tubing in a state of presumable equilibrium have been confirmed. They were found to be confined to sausage-casing type tubing; if tubing was cut open so that the usual washing operation had equal access to both surfaces of the film, the anomalies were found to disappear, suggesting their cause to be impurities resistant to ordinary washing. This finding has a bearing on the common use of dialysis tubing in preparative procedures.

A special type of dialysis vessel was designed to accommodate 1 ml quantities of solution on each side of a circular membrane of approximately 13 mm in diameter. Associated equipment for equilibrium dialysis studies using this type of cell was constructed. With the use of this equipment, study of binding of two amino acids (DL- α -alanine and L-phenylalanine) to carboxypeptidase A was attempted, but was not successful.

Microfilm \$2.75; Xerox \$6.20. 130 pages.

EXCHANGE OF H_2O LIGAND OF TRICHLORO-AQUOPLATINATE(II) WITH SOLVENT

(Order No. 61-3048)

Charles Irvine Sanders, Ph.D.

Iowa State University of Science and Technology, 1961

Supervisor: Don S. Martin

Evidence was found for a rapid but measurable exchange of water between $[PtCl_3(H_2O)]^-$ and solvent. The exchange occurs by means of a direct process in addition to the acid hydrolyses and appears to have a half-time of about one minute. The rate of exchange was measured by the use of H_2O^{18} as a tracer and precipitation of samples as the salt $[Pt(NH_3)_4]_2[PtCl_3(H_2O)]_2$ for isotopic analysis by mass spectrometry.

The rates of the acid hydrolyses of $[PtCl_4]^-$ and $[PtCl_3(H_2O)]^-$ in $K_2[PtCl_4]$ solutions of low ionic strength were determined by titration of the hydrolyzed species and measurement of the rate of chloride exchange between the complex ions and Cl^- (which occurs via the acid hydrolyses). Comparison of the hydrolysis rates with rates for high ionic strength solutions obtained by other investigators showed that the rates were not affected by a ten-fold change in ionic strength of the solutions.

The water exchange and acid hydrolysis results were interpreted in terms of an S_N2 mechanism involving a five-coordinated trigonal intermediate.

Microfilm \$2.75; Xerox \$3.60. 61 pages.

THE CRYSTAL STRUCTURE OF DIHYDROMALVALIC ACID AND THE THEORY OF THE F^3 FOURIER SYNTHESIS

(Order No. 61-3280)

Martin Sax, Ph.D.

University of Pittsburgh, 1961

The first part of this thesis covers the crystal structure determination of dihydromalvalic acid by the X-ray diffraction method from the start of the three dimensional analysis until the completion of two cycles of Fourier refinement. The diffraction data were recorded on multi-film equi-inclination Weissenberg photographs with CuK radiation. Of the 4,275 reflections within the limiting sphere, 2,885 observed and 974 unobserved reflections were recorded. These data were processed using the IBM 650.

The atomic coordinates and the individual isotropic temperature factors were obtained from the $h0l$ projection which had been reported previously by Craven and Jeffrey in *Nature*, vol. 183, p.p. 676-677, March 7, 1959, and from the $0kl$ projection which is reported in this work. The calculated structure factors based upon these parameters yielded an R of 0.33 for 2,885 observed reflections. After two cycles of Fourier refinement, the R dropped to 0.265. Several sections of the three dimensional electron density map obtained from the last cycle of refinement are displayed.

The second part of the thesis comprises a general theory of the $F^3(hkl)$ Fourier synthesis, which is equivalent to the convolution of the Patterson and the electron density functions. The maxima in this distribution measure the degree of coincidence of the maxima in the Patterson and the electron density functions for all possible displacements of the origin of the latter relative to the origin of the Patterson. The principal maxima always occur at positions identical with the positions of the maxima in the electron density function.

When 'mixed' coefficients, $|F_o(hkl)|^2 F_c(hkl)$, are utilized in the Fourier series, the resulting distribution is equivalent to a convolution of the observed Patterson and calculated electron density functions. Since the maxima in this distribution measure the degree of coincidence between the observed Patterson and the assumed electron density functions, they occur at atomic sites in the assumed model that are consistent with the Patterson function with magnitudes proportional to the fraction of the total number of atoms in the model that are in such sites. Systematic coincidences will not occur at those atomic sites that are incorrectly postulated, unless the model has the character of a homometric solution.

A new function for locating errors in a false crystallographic model is derived and is based upon the properties of the convolution of the calculated electron density and a scaled difference Patterson function. If the distribution resulting from the convolution is superimposed, after proper scaling, upon the calculated electron density function, the resulting function possesses maxima at the sites of correctly located atoms with magnitudes in proportion to the product of the peak height in the calculated electron density function and the fraction of the atoms correctly located. At the site of an erroneously positioned atom the peak is diminished to a magnitude proportional to the peak height in the calculated electron density function multiplied

by the reciprocal of the number of atoms in the unit cell. In this manner the error in the model can be found. Maxima that do not coincide with atomic sites in the assumed model are interpreted as possible atomic sites for correcting the model.

The theory of vector sets, first proposed by Wrinch and generalized by Buerger, is extended in a general way to point sets of higher power than two, and the cubed point set, which corresponds in idealized form to the $F^3(hkl)$ Fourier synthesis, is treated in detail. Specifically, the symmetry properties of the error function, described above, are inferred from those of the cubed set. This is accomplished by an extension of Buerger's matrix algebra for vector sets to point sets of higher power than two.

Microfilm \$2.75; Xerox \$7.80. 166 pages.

POTENTIOMETRIC POLAROGRAPHY
AT THE DROPPING MERCURY ELECTRODE:
A TRANSISTOR CIRCUIT FOR
THE SCANNING CURRENT.

(Order No. Mic 60-5049)

Louis J. Sayegh, Ph.D.
Princeton University, 1959

The following study was originally undertaken to examine the possibility of the use of transistors in analytical instrumentation. Since the transistor lends itself to work in the constant current field, its use in potentiometric, or current-scan, polarography is obvious. The adaptability of the transistor to this field was successful.

In Chapter I the original work on the transistor in coulometry is reviewed for the reader. Some work done on the mercury battery, an excellent miniature electrical component, is presented. A thorough discussion of temperature effects on these units is also included.

Potentiometric, or current-scan, polarography is discussed in Chapter II. The design and operation of the transistorized automatic current scanner and its recording system is also included. A discussion is included on potentiometric polarography at solid electrodes as well as at the dropping mercury electrode.

In Chapter III, potentiometric polarography at the dropping mercury capillary electrode is discussed thoroughly and results are given for the cadmium system. A method is discussed for measuring the polarograms that are obtained by scanning with current. The effect of damping by a condenser is also discussed.

Chapter IV deals with the so-called water current, and with the results that are obtained by automatic scanning with current. Because of the unique nature of the recording and damping, the data disproves the idea that the water current is due to the direct reduction of water molecules. The results can only be explained by disregarding this theory and by assuming a reduction of one of the other reducible species that was present in the solution.

Chapter V deals with the use of the oscilloscope and the patterns thus obtained. A representative set of photographed patterns is given. The patterns enable one to estimate the effect of inertia and "over-shooting" of the electromechanical recorder.

In Chapter VI equations are derived to give a theoretic-

cal picture of the odd wave patterns that are observed with the records of individual drops and the wave as a whole. These equations checked qualitatively with the patterns that were obtained with the oscilloscope. The concept of "back-scanning" is introduced to describe the current-density-voltage relationships.

In Chapter VII, the clipping of maxima is discussed, and experimental data are presented on this phenomenon. Maxima were "clipped," i.e., eliminated for the following: Pb(II), Ni(II), Fe(II), Hg(II), O_2 , IO_3^- and p-nitroaniline. These results were compared with conventional voltage-scan polarograms. A discussion of wave shapes, and the two general classes of these wave forms, is given.

In the final Chapter, VIII, the theory of maxima is discussed, especially as it applies to the results that are given in Chapter VII. The reason for the clipping of maxima by the current-scan technique is given. The whole phenomenon is shown to be far more complicated than the description as given by Lingane.

Microfilm \$2.75; Xerox \$4.80. 93 pages.

THE FLASH PHOTOLYSIS OF ACETONE

(Order No. Mic 61-1052)

Avner Shilman, Ph.D.
Polytechnic Institute of Brooklyn, 1961

Adviser: Rudolph A. Marcus

The flash photolysis of acetone was studied at wavelength regions centered around 300, 280 and 260m μ .

The source of radiation was an exploding nichrome wire, and the absorbed intensities were of the order of 10^{18} quanta/cc/sec for each wavelength region. Under such conditions, reactions which are second order in radical concentration predominate over first order ones. As a result, the reaction scheme is simplified and more information can be obtained concerning the primary processes. Moreover the maximum temperature increase per flash of the acetone was calculated to be 5°C.

Previous work in the flash photolysis of acetone has been done, in most cases, in a broad region of the spectrum, the reason being the inadequacy of the techniques used in the analysis of smaller amounts of products. These techniques had another drawback, in that the analysis was not complete, since the less volatile products were not estimated.

This research was undertaken in order to study the flash photolysis of acetone in narrow wavelength regions of the spectrum. Four regions were chosen for this purpose, two in the continuous part (wavelengths centered around 260 and 280m μ) and two in the discrete part of the acetone spectrum (wavelengths centered around 300 and 310m μ). Since in each of the latter regions acetone showed similar behavior, only one of them, 300m μ , was investigated extensively.

In order to overcome the analytical difficulties, a gas chromatography unit employing a very sensitive electric discharge detector was constructed. With this unit, most of the products were analyzed in amounts of 10^{-9} moles.

The results obtained in the photolysis experiments are summarized as follows:

(1) The main reaction products were ethane, carbon monoxide, and biacetyl (equal to ethane less carbon monoxide yield). Methane was a minor product. No acetaldehyde or methyl ethyl ketone were detected. The quantity of the former was negligible relative to the quantity of biacetyl and the amount of the latter was negligible relative to the amount of methane.

(2) The quantum yield of carbon monoxide was independent of acetone pressure (except at 280m μ).

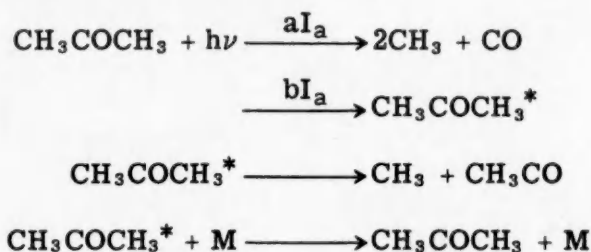
(3) The biacetyl and ethane quantum yields decreased with increasing acetone pressure (except ethane at 280m μ at low acetone pressures).

(4) The C₂H₆/CO ratio at acetone pressures above 80 mm decreased in the order 260>280>300m μ . Below 80 mm the order was 280>260>300m μ .

(5) The quantum yields of ethane, carbon monoxide and biacetyl were independent of a five fold change in incident light intensity at all wavelengths.

(6) The exploding wire behaved as an infinite line source of radiation.

These results are consistent with the following primary processes, leading ultimately to formation of ethane, carbon monoxide and biacetyl:



where CH₃COCH₃* is an electronically excited molecule and M is any molecule. Another primary process involving methane formation, is assumed to involve a "hot" radical as an intermediate. The secondary processes appear to simply involve all possible recombinations of methyl radicals and of acetyl radicals.

In experiments performed at 280m μ the results were similar to those outlined above with two exceptions: The quantum yield of carbon monoxide increased with increasing acetone pressure at 280m μ . The quantum yield of ethane increased with increasing acetone pressure at low pressures (4-10 mm and possibly higher). Because of the first exception, the following induced dissociation is added to the scheme for the 280m μ region:



In experiments performed at 260m μ , the C₂H₆/CO ratio was not reduced to unity even at 1000 mm added carbon dioxide and acetone, unlike the results obtained at the other wavelengths. For 260m μ , the following step is added to those outlined earlier:



From steady state considerations, the lifetimes of the excited state CH₃COCH₃* were calculated and found to be for the respective wavelengths: 300m μ --4x10⁻⁹ sec; 280m μ --1x10⁻⁹ sec; 260m μ --0.6x10⁻⁹ sec.

The results obtained here for the various wavelength regions are comparable to the results of previous high and low intensity studies. Thus, it is possible that excited states play a more significant role in low intensity processes than has hitherto been realized.

The studies of the flash photolysis of acetone have es-

tablished the following types of reactions of the excited state: dissociation, collision, induced dissociation and deactivation by collision. The relative importance of these processes depends on the wavelength at which the excited state is being formed.

Microfilm \$2.75; Xerox \$5.20. 104 pages.

ION MOBILITIES IN FUSED SALTS

(Order No. 61-3053)

Edward Dean Wolf, Ph.D.

Iowa State University of Science and Technology, 1961

Supervisor: Frederick R. Duke

The transport numbers of the chloride ion in pure molten MgCl₂, CaCl₂, SrCl₂, and BaCl₂ were determined using radioactive chlorine 36. A modified Stokes' law was applied to the motion of the individual ions to predict the degree of association of the MCl⁺ ion in these molten salts.

Several trends were observed which were consistent with the chemical properties of the salts. The range of association was approximately 0.20 to 0.80. Association was found to increase for the Group II_A chlorides as the metal ionic radii decreased. The behavior of CaCl₂ was similar to that of MgCl₂ while SrCl₂ behaved more nearly like BaCl₂. The transport number of the chloride ion in MgCl₂ was found to be more dependent on association (i.e., greater increase for the same decrease in association) than in BaCl₂.

Treatment of independent data for ZnCl₂ and PbCl₂ indicated greater association in ZnCl₂ than in MgCl₂, and PbCl₂ was found to exhibit association similar to SrCl₂ and BaCl₂.

Ionic mobilities were calculated from conductivity data using the transport numbers and the relative concentrations of the predicted species.

Microfilm \$2.75; Xerox \$3.60. 61 pages.

AN ELECTRON SPIN RESONANCE STUDY OF AROMATIC HYDROCARBON NEGATIVE IONS

(Order No. Mic 61-2899)

Robert W. Wood, Ph.D.

Cornell University Medical College, 1961

The electron spin resonance spectra of the negative ions of twenty-one aromatic hydrocarbons have been recorded. All negative ions were prepared by reduction with alkali metal in tetrahydrofuran. Special chemical apparatus was designed in order that the chemical reactions could be carried out in an anhydrous state under high vacuum.

Theoretical calculations based on the Huckel LCAO-MO theory were made for each compound. The energy eigenvalues and a complete set of eigenvectors were determined,

each eigenvector defining a particular molecular orbital. A theoretical spin density distribution for each orbital is obtained from the square of the coefficients of the atomic orbitals defining the corresponding eigenvector.

A list of the aromatic hydrocarbons studied is given below:

Naphthalene (1)
 Anthracene (1)
 Naphthacene (1)
 Phenanthrene (3)
 Chrysene (1)
 Anthanthrene (1)
 Benz(a)anthracene (4)
 Dibenz(a,c)anthracene (2)
 Dibenz(a,h)anthracene (2)
 Dibenz(a,j)anthracene (3)
 Pyrene (3)
 Benzo(e)pyrene (1)
 Benzo(a)pyrene (4)
 Dibenz(a,l)pyrene (3)
 Dibenz(a,h)pyrene (1)
 Dibenz(a,i)pyrene (2)
 Indeno(1,2,3-c,d)pyrene (3)
 Fluoranthene (1)
 Benzo(j)fluoranthene (4)
 Benzo(k)fluoranthene (2)
 Benzo(m,n,o)fluoranthene (2)

The electron spin resonance spectrum of each negative ion was analysed to determine the hyperfine coupling constants. The constants, a_n , are directly proportional to the electron spin density, ρ_n , according to the relation:

$$a_n = Q \rho_n$$

A correlation between the coupling constants and the Huckel spin densities was demonstrated in many cases. The hy-

drocarbons denoted by (1) showed good correlation between theory and experiment. Those followed by (2) yielded fair agreement. The spectra of the two dibenzanthracenes and of dibenzo(a,i)pyrene were of comparatively poor resolution which may be responsible for the lack of correlation. The two benzofluoranthenes produced well resolved spectra. In these cases a good correlation was shown to exist for the two largest spin densities. The theory was not so successful in predicting the smaller values. The notation (3) indicates those molecules which were in disagreement with theory. The discrepancy in pyrene is believed due to the occurrence of negative spin density which the Huckel theory does not take into account. Advanced theories are discussed which prove more satisfactory for pyrene, but are less successful for other molecules such as naphthalene. Dibenz(a,j)anthracene presents a unique problem in view of its molecular structure and is discussed in detail. The reason for the discrepancy in the other three molecules marked (3) has not been definitely established. Finally, the notation (4) refers to those molecules for which it was not possible to determine coupling constants because of the lack of symmetry in these molecules.

These hydrocarbons had been tested for their carcinogenic activity with respect to mouse skin. The electron spin resonance spectra were analysed for a possible correlation with carcinogenic activity. Specific values of the coupling constants were examined in an attempt to show such a correlation. When this proved unsuccessful, certain restrictions were placed on the molecules, e.g., carcinogens were required to possess the Pullman K region. However, no clear correlation could be established.

The theories of Pullman, Fukui, Mason, and of Szent-Gyorgyi are briefly summarized. The possible applications of electron spin resonance in each case are discussed.

Microfilm \$2.75; Xerox \$5.60. 111 pages.

ECONOMICS

ECONOMICS, GENERAL

A COMPARATIVE STUDY OF THE UNITED STATES AND CANADIAN ECONOMIES BASED ON SELECTED KEY INDICATORS - 1929 TO 1956

(Order No. 61-3262)

Edmund Russell Hill, Ph.D.
University of Pittsburgh, 1961

Supervisor: Reuben E. Slesinger

The purpose of this study is to examine the hypothesis that despite the disadvantages of geography and a small population, the economic growth and development of Canada during the period of 1929 to 1956 tended to produce patterns of economic behavior similar to those in the United States.

The methodology used in testing this hypothesis was the measurement and comparison of the quantifiable aspects of Gross National Product and the national expenditure accounts for the United States and Canada. The discussion and analysis were concerned mainly with growth and the structural composition of these accounts.

The results of this study show that the growth rates of GNP and consumer expenditures were higher in Canada, but after allowances for population increases the growth rates were similar for both countries. The growth rates of both total fixed investment expenditures and per capita fixed investment expenditures were higher for Canada than for the United States. The most important source of funds for investment in both countries was gross business savings in the form of corporation profits, depreciation allowances, and similar business costs. Personal savings as a source of funds were relatively more important in the United States than in Canada. It was shown that Canada was generally a net importer of funds for investment but that the United States was a net exporter. In the later years Canada depended less on foreign investment as a result of the relative increase of domestic savings as a source of funds for investment. The growth rate of government expenditures was slightly higher in the United States than in Canada. There was a similar upward trend of these outlays in both countries as a result of the relatively larger expenditures by the Federal government. Foreign trade was relatively more important for Canada than for the United States, but during the twenty-seven year period Canada's external trade showed a relative decline. In the same years there was an absolute and a relative increase in the trade between Canada and the United States and a proportional decline with the rest of the world.

It is concluded that the economic growth and development in Canada during the period of 1929 to 1956 resulted in that nation's showing a high degree of similarity to the United States. The most important factor in Canada's

economic growth and development was investment. The rates of new capital formation and net capital formation were consistently higher in that country throughout the twenty-seven year period. The increase of investment was combined with the other factors of production in such a way that the production efficiency of Canada was raised sufficiently to overcome Canada's more rapid growth of population and provide more goods and services for use by the consumer, by the government and by additional investment. It is also shown that any advantage that Canada might possess because of its relatively smaller base was offset by other disadvantages such as climate, kind and location of resources and the large ratio of land space to population. Suggestions are made that Canada's economic growth and development were related to economic and political conditions in the United States as a result of the proximity of the two countries and the intermingling of people and ideas. These aspects were not considered in this study, but it is suggested that they are possible areas for further study.

Microfilm \$2.75; Xerox \$6.60. 136 pages.

A STUDY OF STATE TRADING WITH REFERENCE TO BUTTER TRADE

(Order No. 61-2921)

Richard Ingalls Leighton, Ph.D.
Duke University, 1961

Supervisor: Joseph J. Spengler

This study is an investigation of the impact of state trading on the functioning of the market mechanism. Its purpose is to discover important economic consequences for the importing and exporting countries and the international community. The objective of Great Britain's long-term contracts, covering price and quantity, with Australia, Denmark, and New Zealand was to stabilize the price of butter and to bring the consumption of butter under the Government's program of subsidizing certain necessities in order to forestall inflation. Therefore, one of the purposes of this study is to determine if the sought objective was achieved. The central goal of this study, however, is to discover what effects the contracts had upon the price paid. Finally, the significance of state trading for maximizing world production and optimizing world trade is investigated.

The increase in the price of butter during the period of diminishing subsidization is compared with the rise in the cost of living in order to determine if the subsidization of this commodity had contributed to forestalling inflation. Attention is devoted also to the possibility that the subsidization of butter released money for expenditure upon other commodities and, thereby, encouraged their

prices to rise. The conclusion reached in this study is that the impact of inflation was shifted to other commodities and to other time periods.

The consequences of price stabilization are isolated by comparing the increase in the contract price with the index of the cost of living and with the prices paid by farmers in order to ascertain whether the profits and the incomes of farmers were being stabilized. The conclusion is that since the contract price rose less rapidly than did the cost of living or the prices paid by farmers, both income and profits were reduced as a result of the sale of butter to Great Britain.

Before discussing the principal factor in the relative bargaining strength of Great Britain with four exporters, it was necessary to introduce a new term. Expansibility was used to indicate both a movement along a schedule and a shift of the schedule. It was argued that a nation's expansibility of demand could be represented by the percentage of its total consumption which is supplied by one exporting country and, likewise, that a nation's expansibility of supply to an importing nation could be represented by the percentage that importing country purchased of the nation's total exports of the commodity. It was found that the ranking of the numerical values of the expansibility of supply to Great Britain was consistent with the ordering of the prices received by the exporting nations.

However, the ranking of the numerical values of the expansibility of demand was not found to be consistent with the ordering of prices in a model based on one exporting country's trade with several importing countries. Instead, it was found that the percentage of the nation's total exports purchased by each importing nation ranked fairly consistently with price paid. It is argued that as a result of the exporting nation's dependence on Great Britain, the exporting nation's supply was inexpandible to all markets.

The final task in this study was to determine if the net effect of the subsidies on imports, exports, and consumption hampered the optimization of world trade. It is argued that the net effect of the subsidies was to introduce a pattern of under-trading. That is, the free market price would have been higher in Great Britain than in any of the four exporting countries. Thus, the optimization of world trade was hampered.

Microfilm \$2.75; Xerox \$9.45. 209 pages.

AN INQUIRY INTO UNION STRUCTURE: THE INTERMEDIATE BODY.

(Order No. 61-3144)

Liguori Alphonsus O'Donnell, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Jack Barbash

This study consists of an examination of intermediate bodies within national unions. Intermediate bodies are those forms of structure that intervene between the local union and the national union. The purposes of the study are to discover the extent of intermediate bodies, the functions they perform, the power they exercise, and how they are governed. An effort is made to develop a typology

of intermediate structures and to relate types of intermediate bodies to industry groups in which unions are found.

The thesis is divided into chapters corresponding to seven basic patterns of unionism, as follows:

1. The Craft Union in the Building Trades
2. The Union in a Heavy, Mass Production Industry
3. The Service Trades Union
4. The Union in Public Employment or Public Utilities
5. The Railroad Union
6. The White Collar and Professional Union
7. The Maritime Union

One additional chapter is devoted exclusively to the teamsters' union. Twenty-four unions are included in this survey. Interviews were the main source of material, but constitutions and bylaws were also used. The essential hypothesis is that structure follows function; and, therefore, the requirements of collective bargaining give rise to and determine the form of intermediate bodies.

The investigation reveals that intermediate bodies are a fundamental element in the organizational fabric of American unions. At least seventy national unions utilize them in one form or another. This figure includes all forty-three of the unions in the United States that have more than 100,000 members.

Patterns identifiable by industry were found in railroads where unions employ general committees or system boards; in maritime employment, where coastal districts are typical; in the building trades, where the district council is characteristic. Joint councils or boards are common in service industries, but their functions vary from union to union. Industry-wide or company-wide councils and administrative regions or districts characterize the intermediate structure of unions in heavy manufacturing industries.

Five distinct types of intermediate structure emerge from this survey. One is the district or joint council based upon a metropolitan area and governed by delegates from its constituent locals. The region or district administrative arm of a national union run by an appointed or elected director is a second type. Another is the company or industry council concerned exclusively with bargaining policy and composed of delegates from all locals in the company or industry. A fourth type is the state council with a legislative purpose. Area-wide conferences used mainly for exchanging information by local officials are a fifth type. A less common type is the council or department based upon occupational divisions within the union.

Intermediate bodies are growing in number and assuming greater importance in national unions. In very many cases, they are more important than local unions, and this will be true of even more unions in the future. The reasons for this trend center around the inadequacy of the local to deal with the extremely difficult problems associated with organizing, bargaining, and legal regulation of union administration at the present time. In some unions membership growth and the presence of special groups among the membership gives rise to intermediate structure. Underlying causes of the growth of intermediate structure are economic, but power motives of individual leaders in some cases inhibit its development and in other cases accelerate it.

Differences between intermediate bodies may be accounted for in terms of the framework of the industry, regional characteristics, a tendency of unions to imitate, and the extent of legal regulation in the industry. The variety among those studied is an indication of the pragmatic search for a structure best suited to the task of effective bargaining.

Microfilm \$3.50; Xerox \$12.40. 271 pages.

THE DEVELOPMENT OF CURRENT ECONOMIC PROBLEMS IN THE PRESSED AND BLOWN GLASS INDUSTRY

(Order No. 61-3282)

Richard Henry Slavin, Ph.D.
University of Pittsburgh, 1961

The glass industry is comprised of three distinct branches: flat glass; bottles and containers; and pressed and blown glassware, which category includes tableware, illuminating glassware, and technical and scientific glassware, and which is the subject of this study. Statistics indicate that the manufacture of this type of glassware is a declining industry with serious economic problems. This study will describe and analyze these problems and suggest possible solutions for them.

The primary objective of the study is to obtain an accurate picture of the industry from industrial and governmental statistics, interviews with manufacturers, labor leaders and trade-association officials, and the literature of the industry. The procedure is largely empirical, and the material is organized to define the scope of the industry, to show the history of its economic development, to analyze its current economic problems, and, from the major findings of the study, to recommend necessary public policy to alter unworkable competitive conditions.

Although most manufacturers blame tariff reduction and resultant import increases for the industry's decline, changes in technology and customer preference are the fundamental cause, and the tariff policy is only contributory.

The collective-bargaining procedure has undergone significant modification since 1945. Continued mechanization converted the union from a multi-craft to a semi-industrial union. The 1950-52 labor unrest destroyed the established collective-bargaining methods, replacing nationwide bargaining with area or individual plant bargaining. Since 1952 the union, recognizing the problems of the industry, has generally cooperated in attempting to find solutions for them.

With significant exceptions, the majority of firms in the industry are characterized by antiquated facilities and inept management. The less efficient companies have unimprovable financial conditions, a lack of business leadership, and difficulty in providing an efficient work force. Managerial ineptitudes are demonstrated in personnel relations; in planning for market research, engineering, and financing; and in cost accounting and pricing systems.

Perhaps the most serious problem is raised by the competitive conditions within the industry. The economic structure of the industry shows symptoms of "destructive competition." Increased costs, declining demand, foreign

competition, and substitute products, plus the persistent maintenance of a large supply relative to demand, have reduced profits for many firms and forced others out of business. The basic causes for this destructive competition are a competitive market structure, easy entry to and slow exit of capital and labor from the industry, and historical events creating excess capacity and a redundant labor force. These conditions have caused the industry a difficult readjustment and economic and social inequalities.

Militating against workable or socially satisfactory competition are low industry profit rates and a fringe of inefficiently small firms contributing to overproduction and prohibiting the full use of more efficient facilities. These problems may be best handled by encouraging voluntary removal of resources rather than by governmentally promoted business concentration.

Specific recommendations for the industry include government subsidies for movement of redundant labor from distressed areas, for re-education of labor skills, for conversion of redundant physical resources to alternative uses, and for the purchase and removal from the market of obsolete plant capacity. Governmental measures should be enacted to relieve inequitable income positions of enterprise and labor during readjustment. Firms which, by good management and excellence of product, have survived will continue to survive. Hence, from the point of public policy, the question is not of the survival of the glassware industry but of its economically sustainable dimensions.

Microfilm \$3.70; Xerox \$13.05. 287 pages.

ECONOMICS, AGRICULTURAL

VEGETABLE ENTERPRISE SELECTION IN CENTRAL WISCONSIN

(Order No. 61-3081)

James Leonard App, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Glen C. Pulver

The Central Sand Plain of Wisconsin is one of the most important commercial vegetable producing areas of Wisconsin, because of the development of large scale irrigation, mechanization and market outlets. This study was basically designed to determine the most profitable combination of vegetable crop enterprises within the resource base of commercial vegetable farms in the Central Sand Plain. Crops included in the study were potatoes, snap beans, cucumbers, peppers, tomatoes, sweet corn and field corn. The analysis was specifically directed toward vegetable crop operations where income was obtained from the production and marketing of irrigated vegetable crops.

Cost and return information was developed for the above crops and for the grain and legume crops which were used in the vegetable crop rotations in the Central Sand Plain. The cost and return information represented what commercial growers could accomplish if experimental station recommendations were followed.

Information about the commercial vegetable growers resource base was obtained through a questionnaire which was distributed to all growers in the Central Sand Plain who irrigated vegetable crops. On the basis of the information received from the questionnaire, typical situations were established with three farm sizes, nine variations of investment capital requirements and two levels of management. A total of eighteen distinct situations were established, each with its unique level of resource availability.

An analysis was conducted on the five distinct rotations followed in the Central Sand Plain. Linear programming was selected as the method of analysis to determine the optimum vegetable crop enterprise.

Findings

In all eighteen resource situations the two-year rotation of potatoes and rye was the most profitable enterprise at all resource levels. No other rotation entered the optimum program. The optimum program of potatoes and rye possessed considerable price stability. Tomatoes were the only vegetable crop that offered possibilities of being included in the optimum program. For the other vegetable crops, no price advances were apparent from the base period of prices, which would enable these crops to be included in the optimum program. The analysis indicated that potato prices would have to decline between 37-43 percent to allow consideration of other vegetable crops. During the base period the average prices of potatoes did not decline more than 22 percent from the average price used.

In all situations, the next most profitable vegetable crop program returned less than one-third the returns possible from the potato-rye rotation. The analysis indicated that there was a difference of \$400 net return per acre between the most profitable and least profitable enterprise. It was profitable for growers to acquire additional investment capital in two-thirds of the situations and additional cropland in one-third of the situations. Although other vegetable crops can be grown continuously, their profit potential was not as high as the two-year rotation of potatoes and rye.

The analysis was limited to growers who utilized irrigated vegetable crop production as their only source of income, under conditions where all vegetable crops except potatoes are sold for processing.

Microfilm \$2.75; Xerox \$7.80. 166 pages.

DYNAMIC PROGRAMMING MODELS FOR IDENTIFICATION AND MEASUREMENT OF INEFFICIENCIES IN LEASING ARRANGEMENTS

(Order No. Mic 61-2252)

Gonzalo Jose Correa Arroyo, Ph.D.
Iowa State University of Science and Technology, 1961

Supervisor: John F. Timmons

This study develops a method of dynamic linear programming that permits the introduction of t years of activ-

ities and restrictions ($t=0, \dots, n$) in order to observe the effect of time on resource allocation of farms operated under different tenure systems.

A dynamic model was articulated which (a) meets the goals of an agricultural entrepreneur, that is, maximization of total returns of the terminal year of his planning period; and (b) allows for a fixed yearly amount of family consumption. Specific models for owner-operatorship and crop-share rented farms are presented in detail.

The dynamic model was applied to a farm situation in Iowa in order to detect inefficiencies caused by uncertainty of tenure in customary leasing arrangements. A set of optimal farm plans for different tenure situations on the selected farm was obtained. These included consecutive two-year plans and six-year plans for owner-operators, landlords and tenants, employing different levels of fertilization, conservation practices and livestock investment. It was assumed that a six-year planning horizon is adequate for a tenant under a crop-share lease. Also, another set of optimal plans was programmed with variable capital level.

These results permit to test four hypotheses derived *ad hoc* after evaluating, the firm theory and the economics of leasing systems, and previous empirical results.

The first hypothesis stating that inter-temporal inefficiencies are attributable to the tenant's limited planning horizon in customary crop-share leases is accepted. The empirical results show that such a tenant attains a considerably lower level of returns in the long-run than a tenant under a longer-term leasing arrangement.

The second hypothesis says that inadequate planning horizon for the tenant causes (a) a decrease in the rate of fertilizer application, (b) a decrease in the rate of equipment investment, and (c) a decrease in the rate of adoption of conservation practices such as terracing. The results show that (b) is true for livestock equipment and that (a) and (c) are only acceptable in the case of the steeper lands of the farm studied.

The testing of the third hypothesis indicates that intra-temporal inefficiencies caused by inadequate sharing arrangements between landlord and tenant tend to be accentuated over time. Results coming from the tenant's optimal plans with variable capital unexpectedly show that investment is a monotonic increasing function of capital only in the case of livestock equipment.

The last hypothesis, conditioned to the acceptance of the three previous hypotheses, suggests the remedies for inter-temporal inefficiencies in leasing systems and also for intra-temporal inefficiencies accentuated over time. They are: (a) adequate planning horizon assured by longer-term leases or by agreements whereby the tenant would be fully compensated for potential earnings of investments in case of cessation of contract; (b) better sharing of expenses between landlord and tenant; and (c) modification in the quantity of resources by the two parties and in the sharing of products between them.

Microfilm \$3.05; Xerox \$10.60. 233 pages.

**APPROACHES TO THE ECONOMIC
DEVELOPMENT OF AGRICULTURE
IN EGYPT (U.A.R.)**

(Order No. 61-3083)

Abdel-Mawla Mohammed Basheer, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Kenneth H. Parsons

The United Arab Republic has adopted an Over-all Plan for economic and social development. The Plan has as its stated objective, the doubling of the national income in both the Syrian and the Egyptian Regions of the Republic over the coming ten years (1960-1970). Emphasis has been placed on industrialization in both Regions of the Republic but agriculture has been also given a major proportion of the total investment.

The present study is an inquiry into the approaches which have been followed or might be followed for the promotion of economic development of agriculture in the Egyptian Region. The object of the study necessitated a somewhat detailed study of the human and natural resources of the Region, and an analysis of trends of the developments in these resources so that a diagnosis of the present situation and an appreciation of possible future developments could be obtained.

The cultivated area in the Egyptian Region is very small relative to the population engaged in agriculture and only a small proportion of the labor force is engaged in manufacturing industries. Most of the population in both the rural and urban areas of the Region suffer from poverty and underemployment as well as other social ills associated with them. The economy has stagnated at a very low level of living in both the rural and urban sectors.

The population of the Egyptian Region is increasing at the high rate of 2.5 per cent per year and is shifting rapidly from rural to urban areas. The rural population has increased in number but the urban population has increased at a much faster rate over the last two decades. The prospects are that urban population will more than double over the coming twenty years and the rural population will increase by about one third. Great efforts are needed, therefore, toward both rapid industrialization and bold schemes of agricultural development for the improvement of the well being of the growing population in both sectors.

In agriculture, yields are high on the presently cultivated area but increases in productivity can be obtained through the application of improved technology. However, by far the most important measures for increasing agricultural output and employment are those for the expansion of the cultivated area which is presently very limited comprising only 3 per cent of the total area of the Region. Vigorous efforts are being undertaken for the reclamation of new land. Vast areas of waste land within the Nile Delta and Valley as well as in the Oasis Areas and the Coastal Plain of the Egyptian Western Desert have proven to be cultivable. These lands will be irrigated by water from different sources namely the water which can be made available by economizing on the present water supplies of the Nile, the additional Nile water provided from the High Dam presently being constructed, from underground water of which some dependable sources have been found and from drainage water which can be made suitable for irrigation.

Since 1953, a number of organizations have been formed and have undertaken reclamation works in the Egyptian Region. These organizations have already brought land under cultivation, constructed villages and settled people. In view of the great needs of the Egyptian Region, a much greater number of these organizations is needed than are currently at work. Each organization should have definite and significant plans which must be fulfilled in the specified time. From the experience of the few past years on this work it should be possible to learn ways for reducing the cost of land reclamation and development. This is essential.

Microfilm \$5.60; Xerox \$19.80. 440 pages.

**PROCUREMENT STRATEGIES AND MARKET
BEHAVIOR OF THE WHEAT MILLING AND
BARLEY MALTING INDUSTRIES IN THE
NORTH CENTRAL GRAIN MARKETS**

(Order No. 61-3096)

Arthur Louis Domike, Jr., Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Hugh Cook

The aims of this study are to develop and test hypotheses regarding the market strategies and conduct of wheat millers and barley maltsters in procurement of their grains in the North Central states.

It is premised that market behavior in its various dimensions is determined by the conduct of the market participants. Conduct is governed by the firms' strategies, i.e., rules for guiding market decisions. The choices which a firm may make are a function of competitive, countervailing and institutional aspects of the market environment.

The millers' market structure suggests that no member of the industry is able to affect appreciably the sales opportunities of market opposites or the procurement opportunities of competitors by its unilateral decision. Further, joint strategies by leader firms are precluded by the easy lateral access to suppliers by millers in other regions, by the relatively large amount of external (exporter) competition, and ease of industry entry. The potential gains from any joint strategy would also be limited by the government price support system.

Evidence of millers' market conduct and the behavior of wheat prices in the market support the hypothesis of atomistic market strategies. Millers' use of futures contracts to hedge against price changes indicates that they are unable to predict or control prices. The hypothesis is also corroborated by the wide intra-year variability of protein premiums, and the consistent internal relationship among the premiums.

The maltsters' market structure suggests that the leading firms are capable of altering the procurement costs to themselves and their competitors through unilateral choices. In this non-atomistic structure, maltsters might pursue either independent, non-cooperative strategies or cooperative, non-aggressive strategies to guide their barley market conduct.

The observed dimensions of barley market performance are most consistent with the independent strategy hypothesis.

The frequency, direction and amount of change in malting barley prices and in the premiums of malting over feed barley during 1947 to 1953 crop years are inconsistent with plausible cooperative strategies. However, their conduct does result in greater price inflexibility for top-grade barley, and less consistency of quality-price differentials than would be expected under atomistic buyer group conditions.

Flour millers' processing margins were about 40 percent less variable than that of maltsters' in the 1947-54 period. Millers' margin changes can be closely related to shifts in the demand for flour products and in the active supply of milling facilities. Malting margin variations are apparently unrelated to these influences but are explained by oligopoly-induced lags in product price adjustments to changes in barley costs.

Microfilm \$4.00; Xerox \$13.95. 310 pages.

LAND OWNERSHIP AND USE OF RESOURCES FOR FORESTRY AND RECREATION IN ONEIDA COUNTY, WISCONSIN.

(Order No. 61-3142)

James Arthur Munger, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor C. W. Loomer

Purpose of Study

This study was designed to appraise the effects of land tenure arrangements and characteristics of landowners on the use of rural lands for forest and recreational purposes. The characteristics of individual landowners are often assumed to have little effect on the use of land since, according to traditional economic theory, competition for rights in land results in these resources being allocated to people who are able and willing to make the best use of them from both a private and social point of view. The basic postulate of this study was that ownership factors are important determinants of land use and that an understanding of the functional relationships between land ownership and use will help to extend social control over the use of resources for forestry and recreation.

Method of Analysis

Oneida County, located in northeastern Wisconsin, was selected as the particular focus of this study. Primary data were obtained from a sample of 831 forty-acre tracts of land used in the forest inventory of Oneida County; county tax and deed records; a mail survey of small private landowners; and interviews with public officials, technical experts in the fields of forestry and recreation, and other informed persons. Simple correlation and cross-classification techniques were used to establish relationships between the ownership and use of resources. Although an attempt was made to bring a time perspective into the analysis, most of the findings represent a cross

section of observed relationships at a given moment of time or a discontinuous time series relating present conditions to past events.

Research Findings

Relatively little is known about the ownership and use of rural nonfarm land by private individuals although this is by far the most important group of landowners nationally as well as in the study area. Descriptive information concerning the attributes, motives and land-use problems of this group of owners are therefore of considerable practical interest. A number of empirical relationships between land ownership and use were also established in this study.

The monopsonistic structure of pulpwood markets, imperfections in markets for forest land, and the lack of any organized markets for many outdoor recreational activities prevent landowners from making the most effective use of their land-resources. Public officials and technical experts in the fields of forestry and recreation generally acknowledge that existing channels for resource allocation are not operating effectively. Most individual landowners participating in this study considered institutional factors such as lack of a competitive market for forest products, trespass and vandalism, and policies of public and private organizations to be major land-use problems while only a few owners mentioned personal restraints such as age or income.

Conclusions

Several types of public actions would help to promote the development of resources for forestry and recreation. Encouraging private organizations to assist in the transfer of forest lands and/or providing public assistance and information to prospective buyers and sellers would reduce imperfections in the market for this type of land. From a multiple-use standpoint, tenure arrangements that permit land to be managed for forestry without impairing either on-site or off-site recreational values are preferable to fee simple ownership with its emphasis on exclusive possession and use. It appears desirable that more attention be given to costs and benefits of providing specific public recreational services and more reliance be placed on a system of user fees with payments to private landowners who permit their lands to be used for public recreational activities. Microfilm \$3.20; Xerox \$11.05. 245 pages.

THE STRUCTURAL DEVELOPMENT OF AMERICAN AGRICULTURE

(Order No. 61-3046)

Bengt Arne Nekby, Ph.D.
Iowa State University of Science and Technology, 1961

Supervisor: Earl O. Heady

The main objective of the study included a quantitative analysis of the forces influencing the agricultural industry. Great changes have occurred in the structure of the American agriculture. By making new inputs available and

improving the quality of the old ones, agricultural research efforts are of great interest in this development and have been given particular emphasis.

A simultaneous equations approach of a recursive type was used to construct a simplified model of the agricultural industry. The system contained relations for production, consumption and price of five groups of products: namely, animal food products, food crops, fruits and vegetables, farm industrial products and feed grains. The equations for inputs included the factors: family and hired labor, machines, buildings and operating expendables. The statistical estimation was accomplished by means of the method of least squares and based on data from the period 1935-59.

A multiple correlation coefficient of 0.8 or greater was obtained for most production, consumption and resource equations, but a somewhat lower value for the price relations. Significant coefficients included price elasticities of supply (0.32) and demand (-0.40) for animal products and of demand (-0.65) for fruits and vegetables. On the resource side an elasticity of -0.69 was obtained for the dependence of the demand for hired labor on wages. The estimation indicated a significant direct relationship between agricultural research and the production of feed grains and farm industrial products (elasticities of 0.58 resp. 0.45 were obtained) and gave positive coefficients also in other product supply equations. Moreover, the research variable seemed to increase the demand for operating expendables and machines but diminish the use of hired labor and service buildings.

On the assumptions of a maintained 1959 price support level and a continued growth of population and research expenditures, an attempt was made to predict the agricultural situation in 1965. The results indicate that supply can be expected to grow more rapidly than demand and that, consequently, agricultural prices will have a downward tendency. Net farm income is estimated to decrease by 16 per cent during the six years from 1959. The transfer of family labor to the non-farm sector is predicted to proceed quite rapidly, however, so per capita income is expected to remain approximately unchanged.

In the final part of the investigation an effort was made to develop a technique which would allow a quantitative appraisal of the productivity of inputs in agricultural research and an allocation of the benefits between consumers and producers. It was possible to isolate the effects of research by using the same assumptions except for increased research expenditures in a new prediction for 1960-65 and observe the difference from the previous forecast. The result showed a net return of 43 dollars, per dollar invested in research but was very different for the consumers and the agricultural producers. A loss of 31 dollars was estimated for the latter while the gain of the consumers amounted to 74 dollars.

Microfilm \$2.75; Xerox \$9.25. 202 pages.

ECONOMICS, COMMERCE - BUSINESS

BUYERS' UNDERSTANDING OF PROPERTY AND CASUALTY INSURANCE

(Order No. 61-3197)

William Oscar Collins, Ed.D.
Indiana University, 1961

Chairman: Dr. Elvin S. Eyster

Problem

The problem was a study of buyers' understanding of property and casualty insurance. To solve the problem, two questions needed to be answered:

1. What are the essential understandings of property and casualty insurance which all buyers of personal insurance should have?
2. To what extent do buyers of personal insurance comprehend the essential understandings of property and casualty insurance?

Procedure

The essential understandings of property and casualty insurance were obtained by interviews with 38 high-level insurance officials in branch offices and home offices of property and casualty insurance companies in Illinois, Kansas, and Missouri. The data concerning the extent of buyers' understanding of the essential understandings of property and casualty insurance were obtained from insurance agents and adjusters by the use of an insurance check list. The essential understandings were incorporated in a 50-item check list which was sent to 475 insurance agents and 125 insurance adjusters in Missouri who were asked to indicate one of the following choices about the extent of buyers' understanding of each concept: (1) adequate, (2) some, and (3) little, if any. A total of 416 (69.3 per cent) of the insurance agents and adjusters completed the check list.

Findings

From the large number of important insurance concepts which were obtained from the insurance officials, a list of 50 of the most important concepts was prepared. These concepts were classified in 10 categories: (1) purposes and functions of insurance, (2) economic role of insurance, (3) types of insurance carriers and their operation, (4) regulation of property and casualty insurance, (5) property and casualty insurance contracts, (6) liability insurance, (7) automobile insurance, (8) fire and allied insurance, (9) adjustment of property and casualty insurance claims, and (10) buying property and casualty insurance. In general, the 50 concepts pertained to the broad aspects of property and casualty insurance, rather than to technical terms and specific policy provisions.

Of the 50 concepts, nine were given a rating of "adequate" by more than 25 per cent of the respondents. Only two concepts were given this rating by more than 50 per cent of the respondents. None of the 10 categories of understandings appear to be adequately comprehended. However, the categories pertaining to the purposes and functions of insurance, adjustment of property and casualty

insurance claims, and automobile insurance are much better understood than are the other seven categories.

Observations and Implications

From a study of the findings, the following observations were noted.

1. There appears to be a body of essential understandings of property and casualty insurance which all insurance buyers should comprehend.
2. Buyers' comprehension of the essential understandings of property and casualty insurance vary greatly.
3. Insurance buyers apparently lack an adequate comprehension of the essential understandings of property and casualty insurance.
4. The essential understandings of property and casualty insurance developed in this study are not all-inclusive.

Some major implications of the findings were:

1. Steps need to be taken to improve buyers' understanding of property and casualty insurance.
2. Several groups--educational institutions, insurance companies, insurance associations, and insurance buyers--must share the responsibility for improving buyers' understanding of insurance.
3. Joint action of educational institutions and the insurance industry is needed in developing educational programs for insurance buyers.
4. In all the educational programs, basic understandings rather than specific coverages and policy provisions must be stressed.
5. Additional research appears to be needed regarding the types of educational programs which should be developed for insurance buyers.

Microfilm \$3.10; Xerox \$10.80. 238 pages.

THE CONCEPT OF INDEMNITY IN INSURANCE LAW

(Order No. 61-3095)

James Edward Dillinger, Ph.D.
The University of Wisconsin, 1961

Supervisor: Associate Professor R. M. Heins

The Problem

The concept of indemnity is a nebulous concept which is similar to the idea of reimbursement; yet it is not reimbursement in the true legal meaning of the term. Lexicographers have said that indemnity means "to save harmless." This may be the least confusing and most satisfying definition of the term.

The problem revolves around the foregoing definition and is concerned with the measurement of the harm done to the indemnitee. This problem of measurement embodies consideration of the elements or determinants that are used by the courts in their search for indemnity. Furthermore, it must consider the changing nature of indemnity and the forces which bring about these changes. Finally, the investigation must be limited to cases wherein the indemnity award is coupled with an insurable interest and

exclude the cases involving windfall profits and questions of public policy.

Methodology

The research begins with the statutory expression of indemnity in the English law. It then follows the transition of that expression into the statutory and case law of the United States. The valued policy laws, as major statutory exceptions to indemnity, were also investigated.

The next step was to discover when and to what extent the value-in-use idea had come into American law and to determine its effect upon the value-in-exchange idea which was known to be dominant.

Finally, selected cases were taken from several jurisdictions for comparison with the cases taken from a single jurisdiction. All indemnity cases were then placed in the established categories according to the test used.

Conclusions

Three significant conclusions were reached. The first is that the great majority of jurisdictions use objective criteria exclusively in their search for indemnity, but a slowly increasing minority are using subjective criteria. This conclusion was drawn from the tests used by the courts in the establishment of indemnity awards. The traditional tests are objective and are based on price and cost. Most of the jurisdictions investigated use these objective tests of market price and replacement cost. A minority of the jurisdictions have extended their considerations of value beyond price and cost and include such subjective elements as use and opinion.

The first conclusion gave rise to the second, which is the result of observations of the extent of the use of subjective elements. Only eight state jurisdictions, in addition to the federal courts, have rendered decisions which recognize subjective elements. Another limiting feature, in this respect, is that the courts which have used subjective elements have applied them in very limited areas of indemnity.

The second conclusion is that the concept of indemnity as applied in property insurance cases is slowly undergoing a great legal change, but this change is playing a minor role in indemnity awards.

The courts which use subjective elements in indemnity cases have established a rule called "the broad evidence rule." The third conclusion was drawn from an examination of this rule. The third conclusion is that "the broad evidence rule" uses subjective elements, but its greatest effect lies in the broadening of the objective base. This was clearly established when the elements used in the various applications of the rule were placed in subjective and objective categories. Forty-six different criteria were discovered and classified. More than thirty of these were objective criteria. Six of the criteria were subjective and a few could be argued either way.

The limited application, therefore, of subjective criteria to indemnity cases involving property insurance contracts, excludes their consideration as major factors in the changing concept of indemnity.

Microfilm \$2.85; Xerox \$9.90. 219 pages.

THE ROLE OF THE COMMUNITY COLLEGE
IN THE PREPARATION OF THE
SEMI-PROFESSIONAL OFFICE WORKER

(Order No. 61-3204)

Gilbert Joseph Farley, Ed.D.
Indiana University, 1961

Chairman: Elvin S. Eyster

The Problem

The problem was a study of the potential role of the Dade County (Greater Miami, Florida) Junior College in the preparation of the semiprofessional office worker.

Procedure

The problem involved three different but logically related areas of study: (1) a definition of the semiprofessional office worker; (2) the nature and characteristics of the work performed at the semiprofessional level; and, (3) concepts of junior college education which in this study served as bases for the development of guideposts for junior college terminal, business education.

The definition of the semiprofessional office worker was based on the literature in the fields of occupational classification and the professional businessman. Using the derived definition as a basis for the identification of such workers, a questionnaire was mailed to a systematic, stratified sample of all the offices in Dade County (Greater Miami, Florida) in which it seemed probable that office workers were employed. The sample consisted of 720 names.

The guideposts were developed from concepts as found in both the literature of business education and the junior college, and in the thinking of businessmen and educators as revealed through personal interviews, correspondence or publications. Using the data obtained through the questionnaire and correlating these with the guideposts, the potential role of the new Dade County Junior College in the preparation of the semiprofessional office worker was determined.

Findings

The usable questionnaires returned, which represented 24.0 per cent of the mailing, included 837 office employees of which group 227 or approximately 27 per cent were classified as semiprofessional. Seventy-three per cent of such semiprofessional office workers were either supervisory personnel such as office managers or supervisors, or those employed in the areas of accounting or statistical work. The remaining 37 per cent were divided between secretarial workers and those engaged in specialized types of work. The five top-ranking skills or knowledges required of the semiprofessional office workers were adding-machine operation, composition of letters, typewriting, filing, and preparation of statistics.

The philosophy of the American public junior college is determined generally by two factors: it is an autonomous educational unit and it is created to serve the needs of a particular community. The objectives of the junior college evolve from its emphasis on either the terminal or the preparatory function.

The guideposts developed included the general principles of purpose, balance in terms of both the students' needs and the ratio of general to business subjects, and co-ordination. Specific principles developed included flexibility and adaptability, originality, and co-operation.

Conclusions

From the purposes expressed in its first bulletin and the statements made by its president, it appears that the Dade County Junior College has a practical philosophy conforming to the general philosophy of the American public junior college. Also, there are a sufficient number of semiprofessional office workers in the community to make their educational needs significant.

The new community college in Dade County has a positive, dual role in preparing both the recent high school graduate and the person employed in business for semiprofessional office work.

Microfilm \$2.75; Xerox \$8.60. 186 pages.

THE PROBLEMS BEGINNING SECRETARIES
EXPERIENCE WITH OFFICE DICTATION

(Order No. 61-3205)

Lois Elizabeth Frazier, Ed.D.
Indiana University, 1961

Chairman: Elvin S. Eyster

Problem

This investigation is a study of the problems beginning secretaries experience in the process of taking office dictation and transcribing their shorthand notes. The two aspects of the problem essential to its solution were the identification of the problems and the determination of suggestions for helping secretaries solve these problems. The purpose of the study was to provide a basis for the improvement of office dictation and transcription.

Procedure

Data relative to problems of secretaries were evidences of difficulty, consisting of opinions, facts, and reactions which were obtained during interviews with secretaries and the businessmen who dictated to them. Data pertaining to suggestions for solutions of problems were written facts, opinions, suggestions, and recommendations which were obtained from literature in the fields of business education, including some publications of secretarial associations, and management.

Interviews were conducted with fifty teams of beginning secretaries and dictators in Raleigh, North Carolina, offices. The secretaries had obtained business training after graduation from high school, had worked less than two years, and spent one half or more of their time taking dictation by means of shorthand and transcribing their notes.

The evidences of difficulty were studied carefully, and, from them, problems of the secretaries were deduced. Suggestions for helping secretaries solve each of the problems were compiled from a study of the literature.

Findings

Twenty-three problems were deduced in the following classifications: office organization, policies and regulations, layout and physical facilities, nature of the dictation, and personality traits of the secretaries and dictators. Problems classified according to office organization pertained to orientation, planning dictation, and interruptions. The one problem relative to policies and regulations pertained to punctuation. Problems in layout and physical facilities pertained to space, heating and air-conditioning systems, office noise, adjustment to typewriters, and dictation schedules. Problems in the classification of nature of the dictation pertained to specialized vocabularies, general vocabularies, construction of shorthand outlines, spelling, use of the dictionary, reading shorthand outlines, proofreading, general knowledge, dictators' skills in dictating, and ease of taking dictation. Problems classified according to personality traits of the secretaries and dictators pertained to self-confidence, interference of personal life with business, criticisms and suggestions, and mannerisms of the dictators.

Suggestions for solutions of problems beginning secretaries experience with office dictation have been directed to secretaries, dictators, business firms, business educators, and prospective secretaries. Suggestions have pertained to ways of improving office environment, raising the level of general and special competencies of the secretaries, improving habits of the dictators, and modifying personality traits of secretaries and dictators.

Suggested solutions for many problems of secretaries include improved formal training prior to employment, carefully selected in-service training provided on the job, and self-study before and after employment.

If suggestions are followed, conditions causing problems may be eliminated, thus preventing some problems, and assistance in solving other problems may be obtained.

Inferences

Secretaries need general education, technical or specialized education, and a composite of many personality traits. Beginning secretaries have problems in handling office dictation, and they can expect some assistance in solving problems from dictators, business firms, and educational institutions.

In the final analysis, secretaries must solve most of their problems by: (1) finding solutions to existing problems or (2) adjusting to situations over which they have little or no control. Secretaries should consider the nature of their problems, select tentative solutions, and determine the procedures they will follow in solving their problems, often conferring with other people for advice.

Microfilm \$3.20; Xerox \$11.25. 247 pages.

A COMPREHENSIVE ANALYSIS AND SYNTHESIS
OF RESEARCH FINDINGS AND THOUGHT
PERTAINING TO SHORTHAND AND
TRANSCRIPTION, 1946-1957.
(VOLUMES I AND II).

(Order No. 61-3206)

Inez Frink, Ed.D.
Indiana University, 1961

Chairman: Dr. Elvin S. Eyster

The Problem

The problem is a comprehensive study of the research findings and the thought as expressed in the professional literature pertaining to shorthand and transcription during the period from January 1, 1946, through December 31, 1956.

Procedure

Two types of data were needed for solution of the problem: (1) the findings of research, and (2) the thought as expressed in the professional literature. Primary sources for the first type of data were unpublished doctor's and master's theses and research reports and reports of research printed in professional journals, monographs, pamphlets, and yearbooks not obtainable in other form. Primary sources for the second type of data were publications in which professional literature is printed.

Research studies were obtained through interlibrary loan, from heads of business education departments of institutions granting the degree, or by purchase of microfilms. Abstracts were prepared for 117 reports included in the synthesis and the findings classified. Comprehensive notes were taken of 258 professional articles used to supplement the findings. The findings and thought were studied, analyzed, and a synthesis of both written for each classification.

Findings

The research findings fell logically into the following classifications: determinants of success or failure in shorthand and transcription, instructional materials, analyses and comparisons, general aspects of teaching shorthand and transcription, specific aspects of teaching shorthand and transcription, and occupational information. The research pertained about equally to the different classifications except the specific aspects of teaching shorthand and transcription; the professional literature dealt primarily with the general and specific aspects of teaching shorthand and transcription.

Observations Pertaining to Research
Findings and Thought

The findings indicate considerable waste in the teaching of shorthand and transcription, judging by the high percentage of dropouts and failures in beginning shorthand, low percentage of graduates capable of producing mailable letters, low achievement on mass stenographic testing programs, and disparity between enrollment and job opportunities.

Factors believed to influence achievement in stenography are:

1. Low level of ability of students. This may be interpreted as a need for guidance and selection. Although results of research reveal that both dropouts and failures can be reduced by guidance and selection, seemingly few schools employ either.

2. Need for improvement of instruction. Apparently there is confusion between the objective of stenographic instruction--vocational use--and the best means of achieving the objective or failure to differentiate between the objective of the student--to learn--and the secretary--to produce. Also, there is apparent failure to recognize the purpose for which certain techniques are used or the level of instruction at which they should be introduced or discontinued.

Considerable emphasis is placed on dictation speeds and adjustment techniques despite the fact that research findings indicate greater emphasis should be given mastery of shorthand theory and the related learnings and that dictation rates of 60 to 80 words a minute are satisfactory for ordinary business needs. Also, textbook analyses reveal that, of those so analyzed, none provides for review of all brief forms or principles or for planned and even distribution of either. Lack of uniform classroom and office standards also influence instruction.

3. Need for increased instruction time. Although additional instruction time is believed needed, studies of the relationship of added instruction time to achievement in stenography are not conclusive.

4. Need for nonsymbol shorthand. There is some indication that non-symbol shorthand can be learned in less time than traditional and that it has a definite potential for vocational use.

Microfilm \$7.55; Xerox \$27.00. 596 pages.

AN ANALYSIS OF THE RELATIONSHIP BETWEEN VARIATIONS IN PROMOTION AND SALES OF ETHICAL PHARMACEUTICAL PRODUCTS

(Order No. 61-3108)

Richard John Hampton, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor J. Howard Westing

Over a period of years, several studies have been made which attempted to measure the effectiveness of the use of personal selling, direct mail advertising, and medical journal advertising by pharmaceutical manufacturers in their communication with physicians. Previously, published studies have been of the recall and playback or recognition type describing how physicians remember obtaining information about pharmaceutical products. Since the physician is increasingly exposed to all types of pharmaceutical promotion, it was felt that a modified sales test using available data might provide new clues to the effectiveness of promotion by examining, not what the physician remembers, but how he apparently reacted to the combined stimuli of pharmaceutical promotion.

Data were collected concerning monthly expenditures for medical journal advertising, direct mail advertising, and personal selling or detailing, in addition to monthly sales by new prescription audit. A total of five products, representing three product classes and two manufacturers, were used in the study. The data concerning these products were subjected to various graphic and statistical analyses, primarily multiple correlation analysis.

Comparisons of the sales of several groups of products with the promotional records over the same time period resulted in unmistakable evidence that an ethical pharmaceutical product will not maintain its share of the market after promotion ceases even though the product is marketed by a well known and apparently respected firm.

Coefficients of multiple determination were calculated for the relationship between monthly sales as the dependent variable and monthly promotion by various means such as detailing time and samples, mail literature and samples and several medical journals as the independent variables. The coefficients for the five products were .6711, .5644, .4797, .4533, and .7996, all significant at the .01 level. The size and significance of these values point out a definite relationship between variations in sales and promotional expenditures.

Further analysis using beta coefficients and "coefficients of separate determination" gave less conclusive results as to the relative importance of the independent variables. However, the greatest relationship to sales variations is exhibited by expenditures for space in medical journals, followed by direct mail and detailing.

Investigation of the relationship of promotional expenditures to sales one or two months following the expenditure gave an indication that medical journal advertising is most closely related the month the advertising appears, direct mail the next month, and detailing the second month following the expenditure.

Microfilm \$2.75; Xerox \$7.40. 158 pages.

A STUDY OF MANAGEMENT METHODS AND PROBLEMS OF THE ATCHISON, TOPEKA AND SANTA FE RAILWAY WITH REFERENCE TO THE ADMINISTRATION OF IRANIAN STATE RAILWAYS.

(Order No. Mic 61-1706)

Hassan Sattari-Tehrani, D.B.A.
University of Southern California, 1961

Chairman: Professor Guild

Primary objectives of this study were (1) an examination of the present management methods and practices of the Santa Fe Railway and the Iranian State Railway in the light of (a) certain criteria for good organization and (b) special factors affecting management practices of each railway and (2) the determination of what might be done to bring the Iranian State Railway more fully into accord with good management criteria.

The bulk of the research was done in the Coast Line Division of the Santa Fe Railway. Interviews, questionnaires, and field observations were employed, together

with review of the available literature. The Santa Fe was selected because it is recognized as having excellent management and because many of its operational problems are similar to those faced by the Iranian State Railway. The author is an officer of the Iranian State Railway, vitally interested in its management efficiency.

Findings. Major differences were noted between the situation of the Santa Fe and Iranian State Railway, which account for variations in management practices and requirements. Factors of significance for the Santa Fe are (1) the status of the Company as a private enterprise subject to the earnings test, (2) strong executive leadership, (3) the Company's setting within a much larger railroad industry, (4) competition from other modes of transportation, (5) extensive public regulation, and (6) Company traditions and climate of management motivation and development. These combine to enable the Santa Fe to function with well-recognized efficiency without employing all the formal organizational tools endorsed by many management authorities. The Iranian State Railway, on the other hand, is not under competitive pressures, the profit test, or the challenge of comparative performance with other railroads in the same country. It thus operates without many of the correctives and resources available to the Santa Fe. It is therefore clearly desirable that every useful tool of advanced management and efficient organization be employed fully by the Iranian State Railway, to ensure maximum efficiency and to enable it to plan effectively for its maximum contribution to Iranian progress--social, political, and economic.

Recommendations. In order to improve management of the Iranian State Railway, application of program administration is proposed. Objectives and policies of the railway are clear and can be translated into a pattern of programs, called mission programs. In this manner the work of the organization can be directed, supervised, and controlled through a process of programing. Yet, before this process programing can be developed, the following requirements must be maintained: (1) the preparation of clear and comprehensive statements of objectives and policies, (2) the development of a plan for logical distribution of responsibilities, (3) the development of organization charts and manuals, and (4) the development of controls which will enable management to free itself from unnecessary details of administration.

Microfilm \$2.85; Xerox \$9.90. 217 pages.

ANALYSIS OF REGULATIONS AFFECTING
THE MARKETING OF FLUID MILK
UNDER PENNSYLVANIA MILK CONTROL

(Order No. 61-3281)

Neil Frederick Shiffler, Ph.D.
University of Pittsburgh, 1961

Supervisor: Arend E. Boer

The main purpose of this study is to show the results of resale price regulation upon the distribution of fluid milk under the Pennsylvania milk order, and to evaluate

the regulations in regard to their possible obstruction of, or interference with, the marketing of milk or the adoption of more effective marketing methods.

An analysis of the milk control regulation developed the background, legal foundation, and the actual administration of the program. Margins which existed in out-of-state markets were compared to those established by the state agency for the Pennsylvania marketing areas. An evaluation of the market in regards to the price-fixing regulations was made to discern possible restrictive effects that would warrant amending or revising of existing fluid milk control regulation.

Regulations have provided stability to the industry and have increased income to producers and milk dealers. Retail milk prices would be considerably higher had they kept pace with the increase in consumer incomes and the costs of other commodities. Consumers have been assured of a regular supply of fluid milk at reasonable prices.

The margins and profits of the milk dealers in the state of Pennsylvania are no greater than the margins and profits of milk dealers in other sections of the country. Destructive business practices have been prevented.

Each milk dealer makes an arbitrary allocation of costs when submitting his annual financial statement to the commission. This financial statement usually embraces his entire business, and includes income, expense, and profit or loss pertaining to products whose prices are not regulated. This distorts the profit to investment ratio.

The commission arbitrarily decides which statements to include in the group as a representative basis for costs. Too, there is the problem of determining margins that will apply uniformly to all distributors in the designated marketing areas. No special abilities, education, or knowledge are specified as a qualification for appointment to the agency. An ideal milk administrator should have a knowledge of marketing, economics, and accounting, especially as it pertains to fluid milk. The commission tends to delay or prevent changes in the pricing and distribution that would be desirable and in the public interest.

In order to improve the administration of the Milk Control Commission, standards of accounting should be established for all milk dealers. This would assist the agency in selecting those dealers that had "reasonably efficient" operations. Periodic cost studies should be made. The agency should apply "efficiency factors" in order to arrive at the "reasonable costs" used for pricing decisions.

The milk control law should state the desirable personal qualifications needed for appointment to the commission. Also, formal representation should be made for consumer interests. Permanent committees could be established, preferably in each marketing area, to advise the Milk Control Commission during the hearings held on possible changes in the price order.

Microfilm \$2.75; Xerox \$6.80. 145 pages.

POLICIES UNDERLYING CORPORATE GIVING

(Order No. 61-3288)

Ralph Lingo Thomas, Ph.D.
University of Pittsburgh, 1961

Supervisor: Asher Isaacs

The basic policies and thinking underlying corporate giving were studied and the motivations which cause gifts to be made were given considerable thought. For many years, contributions were made to charitable organizations. However, the A. P. Smith case, known as the Princeton University case, gave considerable impetus to the entire program.

Originally, many organizations that desired financial help for charitable purposes were dependent solely on wealthy individuals. Then, gradually, as large corporations emerged on the National and International scene, they started to assume some of their obligations from this standpoint.

Charitable expenditures are made in the educational, civic, foreign aid and development programs, as well as in many other fields.

Through personal interviews it was found that many of the large corporations have well organized programs. The individuals in charge are well versed in their responsibilities and duties involved. They decide to whom they are going to contribute as well as the amount. Many interesting factors are involved in these decisions.

The methods of corporate giving comprised the following financial methods: aid programs, endowments, grants, loans and other means. Under this classification, other than financial, would be advisory, the broad range of working agreements, donations of physical facilities, and various other arrangements.

Another broad phase is that it is considered good public relations to back certain charitable activities. It is felt that the executives are taking an increasing interest in this broad field. Many feel that a certain amount of funds should be spent in the geographical areas where they earn substantial sums of money.

The optimistic feeling and statements of business leaders as well as the exact plan at the moment in the current business cycle must always be considered. Naturally, the supply of funds is based largely on the current business outlook. A few firms tend to endeavor to spread their payments over a larger period in order to take this into account. One remarked that, in certain important fields, they could not afford to refrain from contributing during any particular year. Otherwise, certain people looking over the donors, would surmise that this firm was not holding its current competitive position.

Literature in the field of corporate contributions to charity was found in Section VI to be unanimous in its conclusion that there is a present pressing need for the corporate entity in this country to support financially charitable organizations of all types and descriptions and educational institutions in particular.

If business continues to hold at present levels, coupled with the current awareness of management, it seems likely that spending for charitable purposes will continue in this high level.

The receiver of all this benevolence is obligated, however, to use the funds wisely and well. A donor will be alert to this always. Microfilm \$2.75; Xerox \$7.60. 163 pages.

ECONOMICS, FINANCE

THE DISTRIBUTION OF WISCONSIN STATE
AND LOCAL TAXES BY INCOME CLASS

(Order No. 61-3092)

Maynard Sheldon Comiez, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Harold M. Groves

The purpose of the thesis was to determine the incidence or ultimate money burden of the state and local taxes levied in Wisconsin in 1956. The research was undertaken as part of the Wisconsin Tax Impact Study.

The introductory chapter reviewed the historical trend of Wisconsin state and local tax revenues and expenditures. This summary was followed by a section discussing the importance of an incidence study. The remainder of the chapter reviewed methodology, sources of data and the limitations of the study.

The second chapter reviewed the history of shifting and incidence theory. The purpose of this review was to provide a background for the subsequent chapter which outlined the shifting assumptions adopted in the incidence study.

Most of the shifting assumptions outlined in chapter three embraced traditional economic incidence theory. The corporate income tax was an exception and two assumptions were made. The first, Case A, assumed that none of the tax was shifted; the second, Case B, assumed that one-third of the tax was shifted.

Several modifications were made throughout the study. One modification was made to reflect two possible market conditions--a closed economy with no interstate tax differentials and an open economy with an allowance for tax differentials between Wisconsin and neighboring states. Another modification was made to allow for the exporting of a part of the Wisconsin state and local tax burden to out-of-state residents via a federal tax offset, the out-of-state consumption of Wisconsin produced products, and the receipt of dividends, arising out of Wisconsin production, by out-of-state stockholders.

The results of the incidence study were presented in chapter four of the thesis. A concluding section compared the Wisconsin incidence study with a similar study for the state of Michigan. A number of technical appendices outlining methodology were attached to the thesis.

The major findings of the Wisconsin study were:

1. The Wisconsin tax structure is regressive in the lower income classes, nearly proportional throughout the middle income range, and progressive in the upper income classes. Much of the regressivity in the lowest income class is due to the particular nature of the people and the type of income included in this class.

The individual income tax is the most progressive tax in the Wisconsin tax system; it is progressive throughout the entire range of income classes. The corporate income tax has a pattern of incidence similar to that for the tax structure as a whole, although it appears to be more progressive in the \$10,000 and over income class. While the pattern of effective property tax rates was similar to the pattern for all taxes in general, the residential property tax was impressively regressive throughout the entire range of income classes.

The Wisconsin tax system does little to improve the distribution of income among Wisconsin residents. The emphasis of the highly regressive property tax in the state and local tax structure is largely responsible for this finding.

Nevertheless, because of the relative importance of progressive income taxes, Wisconsin has a less regressive tax system than most states.

2. Adjusting for tax exporting, the estimated percentage of all Wisconsin taxes borne by Wisconsin residents was 78.63 percent.

3. Whether or not an adjustment is made for tax exporting, the pattern of effective tax rates is essentially the same for each of three income concepts: (1) adjusted gross income (revised to include an amount equal to unshifted business taxes); (2) a broader income concept including "imputed" income and income "in-kind"; and (3) adjusted gross income after federal taxes. The major difference between income concepts was the magnitude of the effective rates.

Microfilm \$3.55; Xerox \$12.40. 275 pages.

A REAPPRAISAL OF CONSTITUTIONAL DEBT RESTRICTIONS IN THE STATES

(Order No. 61-3114)

Arthur James Heins, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor James S. Earley

As a result of financial difficulties encountered by numerous states during the depression of 1837, most states adopted constitutional provisions which limited the debt incurring power of state legislatures. In 20 states, constitutions prohibit debt altogether, with a few minor exceptions; in another 20 states each debt proposal must be submitted to a popular referendum. For the most part, legislatures in the remaining eight states may incur debt without limit.

Since 1900, however, the restricted states have developed revenue bonds, public authorities, lease-purchase agreements, and reimbursement obligations; devices which enable states to borrow without violating constitutional provisions. Based upon his study of the impact of this development upon state borrowing, the author concludes that it would be in the public interest to restore full borrowing power to state legislatures, without referendum requirements, or any other restriction commonly found in state constitutions. This conclusion is based upon the following observations.

1. Because of the development of nonguaranteed borrowing methods, e.g., revenue bonds, state constitutions no longer effectively restrict the borrowing activities of state legislatures. With due consideration for the role of local debt and the interest cost of borrowed funds, states unrestricted in borrowing matters had incurred relatively less debt than referendum states and not substantially more debt than the absolutely restricted states as of 1958. Apparently, the only real restrictions against the amount of state borrowing are the moral and political obligations

of state legislators, which would exist in the absence of constitutional provisions.

2. Present restrictions reduce the number of options available to state legislatures in the planning of a sound debt policy. If borrowing is to be done in restricted states without costly referendums or constitutional amendments, it must be done via one of the nonguaranteed methods.

3. Nonguaranteed borrowing involves higher interest costs because of the greater risk lenders assume. For 1957, 1958, and 1959 the average interest cost of state revenue bonds exceeded the average interest cost of state general obligations by .56%, .48%, and .66% respectively. To the extent that states intend repaying such loans regardless of the outcome of the project for which the funds were borrowed, but because of constitutional restrictions are unable to make this intention known to lenders, the higher interest cost reflects a fictitious shift of risk from the public to the lenders, and hence becomes a real cost to the public.

4. Other consequences of constitutional debt restrictions are the costly administrative procedures required to bypass the restrictions, costly insurance programs for state revenue projects, and the added costs and inequities of the interagency lending of state funds.

Other proposals for mitigating the damaging aspects of state debt restrictions are evaluated, but are opined to be inferior to complete abolition of state debt restrictions.

The study also develops a statistical model by which estimates of the interest differential between revenue bonds and general obligations for specific state projects may be obtained. Among the applications of this model has been to detail the added interest cost of revenue financing in Alabama, Georgia, Indiana, Illinois, Pennsylvania, Washington, and Wisconsin for the period 1956-1959.

Microfilm \$2.75; Xerox \$9.00. 199 pages.

THE ADEQUACY OF BANK PROFITS

(Order No. Mic 61-1324)

Leonard Laudadio, Ph.D.
University of Washington, 1960

Chairman: James A. Crutchfield

Since the end of World War II, bank profits, compared to profits in other industries, have suffered a substantial relative decline. Some observers have concluded that, in view of this decline, bank profits are now inadequate. Since inadequate bank profits may adversely affect not only the banking system, as it is organized today, but also the entire economic structure, it is important to give precision to the meaning of profit adequacy and, at the same time, to set up some criteria by which the adequacy of bank profits can be judged.

Chapter I contains a preliminary statement of the problems involved and presents the method of analysis to be employed.

Chapters II and III constitute the necessary background. The former analyzes, in some detail, the market structure of the American banking system, with reference to the various competitive forces which arise from within the banking

system itself. The latter examines some aspects of the competition between banks and non-bank financial institutions.

This industry study constitutes the basis for Chapter IV, in which the adequacy of bank profits is evaluated according to three criteria: growth, progressiveness, and safety of the banking system.

In an expanding economy, based on free enterprise, a growing, progressive, and safe banking system is necessary. This study maintains that there is a strong link between the three criteria of performance and bank profits, and attempts to indicate whether the performance of the banking system, in any of its major aspects, is being impaired by the relative decline in profits.

The banking system appears to have performed satisfactorily with respect to growth and progressiveness; this indicates that profits have been adequate. However, the weak capital structure of many banks impairs bank safety and indicates that, since profits are the main source of additions to capital funds, profits may be inadequate for a substantial number of individual banks.

The final chapter attempts to reconcile the contradictory results. The market imperfections of the banking industry are of considerable help in reaching a satisfactory explanation. In addition, it appears that the legal restrictions imposed on some forms of bank organization are an essential cause of the low profitability of many banks.

Microfilm \$2.75; Xerox \$7.60. 164 pages.

ECONOMICS, THEORY

A THEORY OF NON-PRICE COMPETITIVE STRATEGY

(Order No. 61-3176)

Jon Gerald Udell, Ph.D.

The University of Wisconsin, 1961

Supervisor: Professor J. Howard Westing

Economists have long recognized the existence of non-price competitive behavior. However, a realistic and useful theory for explaining this important part of 20th century marketing strategy has been lacking. Most efforts to develop such a theory have attempted to relate the use of product and sales effort to the market structure of the industry (e.g., competition, oligopoly, or monopoly).

A Theory of Non-Price Competitive Strategy constitutes an exploratory effort to develop a practical theoretical approach to marketing strategy. The methodology used involves a careful review of business and economic literature and a questionnaire study of 135 successful marketing managements.

The "approach of the product-market" is developed, which emphasizes the nature of the product and the characteristics of the potential purchasers of the product. Five variables are used to delineate the product-market of the firm:

1. Knowledge of the Buyer
2. Technical Nature of the Product
3. Value of the Typical Purchase
4. Effort of the Buyer
5. Purchasers' Buying Motives

Using the above variables, two related hypotheses of non-price behavior are proposed:

1. The importance of the product facet of competitive behavior varies directly with the value of the typical purchase, the efforts of the buyer, the technical nature of the product, the knowledge of the buyer, and the importance of operational buying motives.
2. The importance of the sales efforts facet of competitive behavior varies inversely with the value of typical purchase, the efforts of the buyer, the technical nature of the product, and the knowledge of the buyer, while varying directly with the importance of psychological buying motives.

The data from the study of 135 marketing managements indicate that the product-market hypotheses are valid.

The thesis concludes with a theoretical framework for visualizing the optimum combination of price, product, and sales effort. Within this framework, the author has attempted to use traditional economic tools in a somewhat unique manner. The result is an analysis which:

1. Places no restrictions upon the shape of production cost curves.
2. Emphasizes the role of product and sales efforts.
3. Recognizes both the profit and security motives of business management.
4. Utilizes total costs which are easier to visualize and compute than marginal costs.

Microfilm \$2.75; Xerox \$6.40. 133 pages.

EDUCATION

EDUCATION, GENERAL

CONFORMITY IMPLICATIONS OF CERTAIN CURRENT SECONDARY EDUCATIONAL THEORIES

(Order No. Mic 61-2877)

William H. Boyer, Ed.D.
Arizona State University, 1957

Abstract not available.

Microfilm \$3.50; Xerox \$12.40. 272 pages.

ARITHMETICAL UNDERSTANDINGS AND ATTITUDES TOWARD ARITHMETIC OF EXPERIENCED AND INEXPERIENCED TEACHERS

(Order No. Mic 61-1468)

Edward Dietz Brown, Ed.D.
The University of Nebraska Teachers College, 1961

Adviser: Dr. Leslie L. Chisholm

THE PROBLEM

The purpose of this investigation was to determine the arithmetical understandings and attitudes possessed by a selected group of in-service and prospective teachers of arithmetic.

A review of the related literature made it apparent that authorities not only agree that meanings and understandings should be taught but also that teachers must possess a sound knowledge of those concepts in order to successfully teach arithmetic to children.

The literature also pointed out that teachers can do much to promote the future success of their students in arithmetic by the way they act or the attitudes they exhibit.

THE PROCEDURE

The data used in this investigation can be classified into three parts. It was necessary to determine a measure of the arithmetical understandings of certain selected teachers, a measure of these same teachers' attitudes toward the subject of arithmetic, and the extent of the high school and college mathematics background of each.

The teachers selected for investigation can be divided into two categories. The 1959 elementary education graduates of the University of Nebraska were chosen as the prospective teachers. A similar number of experienced teachers was selected from those persons attending the University during the 1959 Summer Session.

To secure the above-mentioned data Glennon's Test of Basic Mathematical Understandings and Dutton's Attitude Toward Arithmetic Scale were used.

After the selected teachers were tested their college records were examined to determine their mathematics backgrounds. The results of the test, the scale, and the examination of records were recorded and the data analyzed.

THE CONCLUSIONS

In presenting and evaluating the data collected for this investigation there was evidence found for the formulating of the conclusions which follow:

1. Since the understandings tested were of a seventh grade level the mean score of both groups of teachers was lower than could be hoped.

2. Experienced teachers have a better grasp of basic mathematical concepts than those who have not taught the subject.

3. Teaching a number of years does not seem to increase the level of achievement of the basic mathematical understandings.

4. Those teachers who have taken college mathematics courses have a better grasp of the basic mathematical concepts involved in arithmetic than those who have had no college mathematics.

5. Those concepts difficult for experienced teachers are also difficult for inexperienced teachers.

6. The most difficult concepts for teachers to understand are those involved in decimal fractions and their processes and in the rationale of computation.

7. Teachers who have taught arithmetic have a higher attitude toward the subject than those who have not taught.

8. Teaching arithmetic for a number of years does not seem to increase the level of attitude toward arithmetic over those who have taught only a few years.

9. The evidence relating to the effect of college mathematics courses on attitude was inconclusive.

10. Most teachers reflect a favorable to neutral attitude toward the subject of arithmetic.

11. Teachers who reflect an unfavorable attitude toward arithmetic do so because they do not understand the basic concepts involved in the subject.

12. Those teachers who have a high degree of understanding of the basic concepts involved in arithmetic have a positive or high attitude toward the subject.

Microfilm \$2.75; Xerox \$6.60. 139 pages.

**A STUDY OF EDUCATION, VOCATIONAL
TRAINING AND OCCUPATIONAL EXPERIENCE
OF SELECTED INMATES OF THE
INDIANA STATE REFORMATORY**

(Order No. 61-3198)

John Oliver Conaway, Ed.D.
Indiana University, 1961

Chairman: Dr. Louis Schmidt

Problem

The problem was to analyze the educational attainment, the occupational experience, and other selected characteristics of a sample of the inmates incarcerated in the Indiana State reformatory. The major purpose of the study was to discover those factors which might be of value to the State Department of Correction in the treatment and rehabilitation of young men between the ages of 16 and 21 who were incarcerated in the reformatory. Another purpose was to attempt to determine the ability of the sample to profit from a program of vocational training and general education. An incidental purpose of the study was to reveal to what extent the sample had received any vocational education and what vocational education was available in the last school attended.

Procedures

A case history data guide was developed to elicit the information from the case history records of the selected inmates. The related literature and a copy of the Indiana Reformatory admission summary were reviewed to secure pertinent information which should be included in the case history data guide. The reformatory case history records of each inmate contained records of sentence to the reformatory, family history, educational background, admission interview report, military service, and civilian employment. A careful inspection of the case history records of the inmates committed to the reformatory during the calendar year 1955 revealed a total population of 193 young offenders who were from the age of 16 to 21 years. These were the age limits established for the study.

Findings

(1) The subjects had enrolled in school at about the normal age of six years and remained in school until about the age of 16. Only eight remained in school to complete grade 12, while 68 per cent were classified as average or above in intelligence. (2) Almost 75 per cent left school to secure employment and 71 per cent were unemployed at the time of arrest. (3) The employment which had been secured by the subjects was in the unskilled occupations. (4) The illiteracy rate for the subjects was about six times greater than for the general population. (5) The criminal history revealed that the subjects had been arrested an average of three times, and some as high as ten times before commitment to the reformatory. About 80 per cent of the crimes committed by the subjects were for some form of theft. (6) About 72 per cent of the subjects who ranged in age from 15 through 17 were committed to the reformatory within three years after dropping out of school.

(7) About 60 per cent came from broken homes and over 75 per cent had never attended or belonged to a church group.

Conclusions

(1) The employment opportunities of the subjects were limited to the low paying, unskilled jobs. (2) The most critical time for the subjects, who were also school drop-outs, for securing employment was the first three years after leaving school. (3) There was a need for the development of follow-up, counseling, and placement services to assist the subjects and other school drop-outs in making the transition from school to work. (4) Vocational Trade and Industrial Education courses were available to only a few of the subjects. (5) The public schools as one of the agencies which work with youth should play a significant role in identifying potential delinquents. (6) The prevention of delinquency is essential and of national and international concern and no one approach is likely to be completely successful. (7) The treatment and rehabilitation division of the reformatory should utilize the knowledge concerning intelligence and occupational aptitudes in developing a training program for the inmates.

Recommendations

(1) The school should explore the possibility of more cooperatively working with the local employment security office in counseling and assisting the school drop-out in securing employment. (2) That more research be encouraged concerning delinquency prevention, developing effective screening devices to identify potential delinquents, and to determine the effectiveness of the rehabilitation of juvenile delinquents.

Microfilm \$2.75; Xerox \$6.00. 123 pages.

**THE CURRICULUM OF THE SENIOR HIGH
SCHOOL; A SURVEY OF OFFERINGS,
CHANGES, AND TRENDS IN THE
SOUTHERN APPALACHIAN REGION.**

(Order No. Mic 61-2872)

Roy Leonard Cox, Ed.D.
The University of Tennessee, 1961

Major Professor: Earl M. Ramer

The present study was one of seven in a general study of education in the Southern Appalachian Region. Education was one of sixteen areas covered by a greater study of the Region.

The broad aim of the greater study and thus also of the general education study and its sub-studies was simple; to provide accurate, objective data on important aspects of the Region in order that more adequate plans for future improvement might be made.

Data included were obtained through the use of historical research, and the normative survey. Both the mailed questionnaire and the controlled interview were utilized.

The people of the Region were found to be as unlike from place to place as was the Region itself and the schools which the children of the Region attended.

The authority for establishing minimum state requirements was found vested in state boards and state departments of education, state constitutions, and state legislatures. The state board of education was the authority most often encountered.

Considerable supervision of special subject-areas at the state level was found, being higher for the Region than the nation as a whole. The trend was toward increased supervision.

Most of the states reported standing, steering, or coordinating committees in force by 1960. Subject-area committees were found in five of the seven states. All states had one or more curriculum committees not organized according to subject areas.

Courses required most frequently at the state level were English, American history, physical and health education and some type of science and mathematics. Few courses were specified at the local levels beyond the state minimum requirements. Little change was found in either state or local requirements between 1938 and 1958.

Offerings ranged from twenty-four and one-half units of eighteen separate subject areas in one rural high school to 124 - 1/2 units of fifty-eight subject areas in one large urban high school.

Respondents approved of lay participation in curriculum matters, but revealed uncertainties concerning the nature of this participation. They believed that lay criticism of current educational practices had resulted in considerable pressure upon the systems to increase offerings and requirements and upon students to elect courses slighted in the past.

Microfilm \$2.75; Xerox \$9.25. 205 pages.

A STUDY OF THE SPEECH DEVELOPMENT OF PRIMARY GRADE CHILDREN IN RELATION TO CERTAIN PERCEPTUAL, INTELLECTUAL, AND SOCIOLOGICAL FACTORS.

(Order No. 61-3324)

Erwin Brownell Dexter, Ed.D.
Boston University School of Education, 1961

Problem

This was a study to investigate the predictive value of certain auditory discrimination, visual discrimination, intelligence, and socioeconomic factors for the speech development of primary grade children.

Procedure

The sample of 149 children with misarticulations was obtained by a picture articulation test. They were selected from the kindergarten population of Hempstead, New York, in January, 1959. Related data on chronological age, sex, intelligence, family occupational status, and race were obtained from pupil records. All subjects were in normal physical health, had intelligence quotients of 90 or better, had essentially normal vision and hearing acuity. Certain

auditory and visual discrimination factors were compared with speech development during the year between the last half of kindergarten and the first half of first grade. The control variables: family occupational status, sex, race, chronological age, and intelligence were compared with speech development. In like manner, speech sound discrimination was compared. The predictor and control variables were studied by analysis of variance or the chi square test.

Major Findings and Conclusions

1. Rank on the initial articulation test did not serve as a predictor of articulation growth. The rate of growth between January and the following September was substantially the same as that between the first and third administration one year later.
2. The correlations of speech development with either the Auditory or Visual Discrimination Tests revealed that they were not predictors of speech development. However, the correlation of the combined auditory and visual discrimination scores with speech development was .22, significant at the .05 per cent level. This showed a degree of prediction.
3. For the occupational groups, when compared with each other, the means, though different for the four classes, revealed that all occupational groups improved at a similar rate, indicated by an F of 9.29, significant beyond the .01 per cent level.
4. For the girls, when compared with the boys, the difference in mean articulation indices was in favor of the girls who achieved earlier speech maturation. However, females did not improve any more rapidly than males.
5. The white group, when compared with the Negro group, demonstrated continuous growth in articulatory ability. The Negroes regressed from the second to the third testing.
6. For subjects of 72 months or more, when compared with subjects of 71 months or less, both groups improved at the same rate.
7. For subjects with intelligence quotients of 110 to 137, when compared with subjects of intelligence quotients of 90 to 109, the mean articulation indices were higher. Nevertheless, both groups improved, indicated by an F of 8.43, significant beyond the .01 per cent level.
8. Speech sound discrimination, as measured by the Boston University Speech Sound Discrimination Picture Test (Short Form), was not effective as a predictor of speech development.
9. The articulation index was found effective, in a very gross fashion, as a predictor of speech sound discrimination, as measured by the Farquhar Test.
10. The Farquhar Test revealed that children with severe misarticulations had poorer speech sound discrimination ability when compared with children with mild misarticulations. This was substantiated by chi squares significant beyond the .05 per cent level. Girls, when compared with boys, were found

to have greater ability in speech sound discrimination. A relationship was in favor of children in the higher range of intelligence in speech sound discrimination.

Possible Implications

The results of this study confirm those of other studies in showing no relationship between speech development and auditory discrimination ability. They also suggest the need for further studies of the relationships of intelligence and combined auditory-visual discrimination tests to speech development. Combining the results of this study and previous research, it appears that children with many misarticulations, in proportion to their chronological age, who have poor speech sound discrimination, poor auditory and visual discrimination on reading readiness tests, low normal intelligence, and come from lower socio-economic groups, are poor risks for acquisition of normal articulation through maturational processes alone.

Microfilm \$2.75; Xerox \$9.00. 199 pages.

STUDENT ASSISTANT PROGRAM IN SELECTED JUNIOR COLLEGE LIBRARIES

(Order No. Mic 61-2528)

Helen Kerr Earnshaw, Ed.D.
University of Southern California, 1961

Chairman: Professor Olson

The purpose of this study was to ascertain the organization of student assistant work programs in libraries of certain selected junior college libraries throughout the United States, to appraise the administration and operation procedures of these programs, to determine the educational values accruing to students from their work in the library, and to recommend improvements in student assistant programs in junior college libraries.

A review of the literature revealed that the subject matter concerning library student assistants covered ten topics: (1) selection, (2) training and orientation, (3) library standards, (4) services performed, (5) salaries or other types of remuneration, (6) evaluation of work, (7) public relations, (8) organizations, (9) recruitment, and (10) general education values of library work.

After reviewing the literature a questionnaire was constructed. The topics were organized into six general areas: (1) selection, screening, and testing; (2) orientation and rating; (3) budget and payroll; (4) personnel data; (5) qualifications of student assistants; and (6) types of work performed by student assistants. This questionnaire was mailed to thirty-one librarians in junior colleges with less than 1,000 enrollment for the purpose of testing and refining its contents. Responses indicated that very few changes were necessary in the questionnaire. After revision, the questionnaire was then sent to libraries in junior colleges with an enrollment of 1,000 or more.

Findings. A tabulation of responses showed that (1) 90 per cent of the librarians had final authority to select, appoint, and dismiss student assistants; (2) the well-

qualified applicant who applied for work at an earlier date was selected in 70 per cent of the libraries; (3) 90 per cent of the librarians reported that student assistants were paid and received no class credit; (4) 84 per cent of the respondents advised that there was individual orientation by a student's supervisor; (5) the seven qualifications listed as essential by two thirds or more of the librarians were dependability, accuracy, willingness to conform to library regulations, courtesy, ability to alphabetize, good work habits, and the capability of working well with others; and (6) twenty-eight different types of work of a routine and a more-than-routine nature were assigned to student workers.

Conclusions and Recommendations. It was concluded that (1) selection and orientation should originate with the library staff; (2) student library assistants should be paid employees; (3) these library assistants should have desirable personal traits and definite abilities; (4) they should perform specific duties; and (5) at the same time, they should receive educational, personal, and vocational benefits from library work. It was recommended that (1) more libraries operate student assistant programs as workshop or laboratory type of training; (2) pre-service group orientation be provided; (3) there be a probation period for each new student employee; (4) a library training manual be provided for every student employee; (5) there be a formal rating system for evaluating the services of each student helper; (6) a sliding pay scale be put into operation; (7) librarians assign a wider range of duties to student assistants according to ability to perform higher-level types of work; (8) librarians encourage and sponsor student library assistant organizations; and (9) a follow-up be made on former student library workers.

Microfilm \$2.75; Xerox \$8.60. 187 pages.

AN ANALYSIS OF FARM MECHANICS KNOWLEDGE AND SKILLS NEEDED BY WISCONSIN FARMERS

(Order No. 61-3119)

Arthur Kenneth Jensen, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Walter T. Bjoraker

The analysis of farm mechanics knowledge and skills needed by Wisconsin farmers was performed to determine which of the one hundred and forty-three pre-determined mechanical skills were actually being performed, and what attitudes Wisconsin farmers had toward training as preparation for the performance of these skills. The study was designed to be inclusive of the geographical boundaries of Wisconsin, inclusive of all areas of Wisconsin, of sufficient magnitude to include at least one percent of the farmers of Wisconsin, representative of Wisconsin farmers, and inclusive of all major areas of farm mechanics skills.

A mail questionnaire was used to collect data from farmers who were cooperators with the Wisconsin Crop Reporting Service. The data were tabulated and analyzed on the basis of 2,464 usable returns from farmers throughout the entire state.

Thirty-seven percent of the total responses indicated that no training was needed for performance of the skills studied, fifty-five percent indicated these skills should be hired performed.

Farmers over fifty-five years of age indicated less need for training as preparation for a skill than did those under fifty-five. The expression of need for training increased as the educational achievement level increased. Respondents having had vocational agriculture expressed a greater receptiveness toward the desirability of training than did those not having had vocational agriculture.

In the performance of the one hundred and forty-three farm mechanics skills included in this study there were sixty-three that had been performed by thirty or more percent of the respondents. Of these sixty-three, thirty-one had been performed by over fifty percent of the respondents. There were eighty skills, or fifty-six percent, that had been performed by less than thirty percent of the farmers. There were only twenty-two percent of the skills that had been performed by fifty percent or more of the respondents.

In forty-one of the skills included in the study, over fifty percent of the respondents inferred no training was needed for performance of the skill. In ninety-five of the skills over fifty percent of the respondents expressed the view that training of some degree was desirable. There were eleven skills in which twenty-five percent or more of the respondents indicated the skill should be hired performed. Of the thirty-one skills performed by over fifty percent of the respondents, there were only thirteen, or forty-two percent, in which fifty or more percent of the respondents desired training. Of the eighty skills performed by less than thirty percent of the respondents, there were sixty-two, or seventy-seven percent, in which fifty percent or more of the respondents expressed desirability of training.

The study indicated that there was a need for training for the performance of many of the skills studied. The study pointed out that farmers realized the desirability of training for the performance of ninety-five of the one hundred and forty-three skills analyzed. After the data was analyzed, it was noted that farmers responding to this study differed from the average Wisconsin farmer in several regards despite the design of the study. They operated larger farms, were slightly older, had a few more years of farm operation, and were more generally owners of the farms they operated.

Microfilm \$2.75; Xerox \$6.40. 135 pages.

AN ANALYSIS AND EVALUATION OF LEGISLATIVE POLICY CONCERNING PUBLIC SCHOOL CURRICULUM IN INDIANA

(Order No. 61-3212)

Kenneth Forbis Jordan, Ed.D.
Indiana University, 1961

Chairman: Dr. Maurice McGlasson

Introduction. To do their jobs effectively, personnel working in the area of curriculum development should be acquainted with the requirements imposed upon them by

such extra-community influences as colleges and universities, the state department of public instruction, the statutes enacted by the state legislatures, and the interpretation of law as reflected in court decisions. Knowledge of statutory requirements and court decisions is of utmost importance because local school authorities have only those powers expressly granted to them. School officials need a working knowledge of these areas to fulfill the legislative requirements and to work effectively to bring about changes, if desired.

Statement of the Problem. The major objectives of the study were to: (1) determine the policy of the Indiana General Assembly with respect to the curriculum in the public schools of the state; (2) determine how this policy has developed; and, (3) determine what recommendations should be made in regard to future directions for this legislative policy when it is compared with the recommendations of selected authorities in curriculum and school administration relative to the desired role or function of the legislature in curriculum making.

Sources of Data. Indiana Session Acts, 1816-1959; Official Opinions of the Attorney General of Indiana, *North-eastern Reporter*, and West's *Indiana Digest*.

Findings, Conclusions, and Recommendations. The Indiana General Assembly has enacted 66 statutes which have contributed to the formulation of the legislative policy concerning public school curriculum in Indiana. The related literature and research reviewed in the study disclosed considerable agreement concerning an excessive number of mandatory requirements in the statutes which have been enacted by the various state legislatures.

A comparison of the policy observed in the study with the recommendations of selected authorities seemed to justify the following conclusions:

1. Curriculum legislation enacted by the General Assembly has established the recommended minimum program, but has gone beyond this program in certain areas and has outlined specific steps to be followed in implementing the program.
2. Rather than provide for the recommended service and leadership from the state level, the General Assembly has tended to make the State Department of Public Instruction a regulatory agency through which the statutes are to be enforced.
3. Little curriculum legislation was found which was purely obsolete even though legislation once enacted tends to stay in force.
4. Few statutes contain penalty provisions for failing to fulfill their provisions; however, most statutes have established minimums which local school authorities could exceed at their discretion.
5. The General Assembly has not consistently left the setting of standards and technical requirements to the State Board of Education, but has enacted some very detailed statutes and some very general statutes which gave local school authorities broad discretionary powers.

The findings and conclusions seemed to justify the following recommendations: (1) the Indiana school laws should be codified so that statutes in effect can be determined and (2) future legislation should be broad in nature, delegating the specifics to the State Board of Education or one of its agencies. Microfilm \$2.75; Xerox \$7.60. 163 pages.

THE DEVELOPMENT OF A PLAN FOR
VOCATIONAL TRAINING AT THE
ALABAMA INDUSTRIAL SCHOOL FOR
NEGRO BOYS AND GIRLS

(Order No. 61-3214)

William Edward Lightfoote, Ed.D.
Indiana University, 1961

Chairman: Dr. Earl P. Tregilgus

Problem: The purpose of this investigation was to analyze the educational program of The Alabama Industrial School at Mount Meigs, Alabama with a view to determining what vocational training might appropriately be offered there.

Procedure: This investigation was limited to an analysis of the educational and extra-curricular activities. The investigator was a participant observer, in that he took an active part in the experiences of the students throughout the institution. A total of 206 students above the age of 15 years were interviewed. Interviews were held with all employed personnel. Courses and methods of instruction were checked. Buildings and equipment were inspected and observed in terms of what they could contribute to an effective vocational training program. Students who had been discharged and out looking for jobs, on jobs, or in school were contacted to get information relative to problems they experienced. A sample of the students on parole were given personal interviews.

The information and data derived from the investigation were organized and discussed under the following general topics: (1) The present student body; (2) The educational or academic program; (3) The vocational or trade program; (4) The extra-curricular activities; (5) The housing arrangements; (6) Parole and follow-up; and (7) The results of questionnaires sent to former students.

Findings: The following were major findings of the investigation:

1. Sixty-four per cent of the students were either out of school, unemployed, doing odd jobs or common labor at time of arrest.
2. The trade training units or details were charged primarily with institutional operation and maintenance rather than vocational instruction.
3. Academic retardation was present.
4. Every student was enrolled in the academic program.
5. Over three-fourths of the students indicated that they would enroll in a vocational course of their choice if it were offered.
6. Forty-one per cent of the students who had been discharged could not find employment, or were doing odd common labor jobs during the first three months after leaving the school.
7. Only limited selection was available to the students to get on the units or details they preferred.
8. Recruiting and holding a competent staff created a major problem.

9. An average of 4 students were discharged each week, and that same number were admitted. Students remained for about 2 years, and the average daily enrollment was about 400.
10. Modern and adequate facilities were not available for all areas of the academic program.
11. The expressed vocational choices of the students were in line with their scant knowledge of the work-a-day world.
12. Provisions were made for practically every student to participate in some recreational hobby or avocational activity.
13. Individual instruction as stressed failed to develop certain social skills, cooperation, and group communication that would be obtained if more whole-class activities were used.
14. A student is on parole for one year after leaving the institution, after which he is automatically discharged. No follow-up records are kept thereafter.

Conclusions: From the pertinent data indicated in the findings of this investigation, the following conclusions were formulated:

1. Since the majority of the unit or detail leaders were instructors who had limited formal training for the activities they were directing, there is considerable doubt about the effectiveness of their teaching.
2. The findings seem to indicate that the students do need to be trained in a trade or vocation with which to earn a living when they are released.
3. No program of vocational education is likely to succeed until most of the staff members become fully imbued with the treatment and rehabilitation philosophy.
4. The systematic methods of daily procedures have been a distinct advantage to those students who were irregular in school attendance and in habits of thought and action before coming to the institution.
5. Until training takes precedence over production, there is little likelihood that an adequate vocational program can be initiated and maintained.

Microfilm \$2.75; Xerox \$5.60. 112 pages.

A BIRACIAL STUDY OF ENTRY JOB FACTS
FOUND AMONG SELECTED MANUFACTURING
AND RESEARCH INDUSTRIES LOCATED IN
METROPOLITAN KNOXVILLE, TENNESSEE,
AND THEIR IMPLICATIONS FOR SELECTED
SECONDARY SCHOOLS AND COLLEGES.

(Order No. Mic 61-2874)

Ralph H. Martin, Ed.D.
The University of Tennessee, 1961

Major Professor: Laurence M. DeRidder

This research was designed: (1) to determine entry job facts found in selected manufacturing and research

industries located in Metropolitan Knoxville, for high school, non-college, and college graduates; (2) to report educational experiences leading to industrial employment provided at selected secondary schools and colleges; (3) to describe guidance programs at the reported educational institutions; (4) to make implications for secondary schools and colleges and other elements of community life; (5) to provide valid information to school administrators as guides to curriculum planning; (6) to assemble job facts useful to guidance counselors to aid high school, non-college, and college graduates to make occupational choices; (7) to acquaint guidance counselors with local industrial employment opportunities; (8) to discover new work opportunities for Negroes; (9) to understand factors considered important by employment officers in the employment process; and (10) to develop closer relationship between educational institutions and industry.

Six industries employing approximately 18,000 Negro and white workers reported in this research were: Atomic Energy Commission, Oak Ridge; Dempster Brothers Manufacturing Company, Knoxville; Oak Ridge Institute of Nuclear Studies, Oak Ridge; Rohm and Haas Manufacturing Company, Knoxville; Tennessee Valley Authority, Knoxville Division; and Union Carbide Nuclear Company, Oak Ridge.

Entry job facts found in the professional, clerical, and skilled major occupational groups were determined, and each job was discussed in relationship to eight aspects of occupational understanding, namely, nature of work, job preparation, economic returns, personal requirements, number and composition of workers, working conditions, entry to job, and job outlook. Interviews were conducted with the employment officers, and responses were tabulated on Interview Form A.

Educational experiences leading to industrial employment and guidance programs at two high schools, Austin (Negro) and Fulton (white), and two colleges, Carson-Newman (white) and Knoxville (Negro) were reported in this research. Interviews were conducted with school administrators to obtain subject matter courses, graduation requirements of majors or minors in educational programs leading to industrial employment. Information obtained from school administrators and guidance counselors was recorded on Interview Form B.

From entry job facts in the professional, clerical, and skilled major occupational groups among six manufacturing and research industries, and educational experiences leading to industrial employment provided at four educational institutions, together with guidance programs at the institutions, some of the findings were: (1) a substantial number of jobs found in the professional major occupational group required college graduation, with major or minor in subject matter areas requiring above average academic achievement; (2) entrance salaries on jobs in this major occupational group ranged from \$4000 to \$5540 per year, with fringe benefits; (3) a substantial number of jobs are open to qualified Negroes in the professional major occupational group, but very few make application; (4) jobs in the clerical major occupational group required high school graduation or above, with special skills in typewriting, stenography, business machine operation, business English, and filing; (5) entrance salaries for clerical jobs ranged from \$3000 to \$4000 per year, with fringe benefits; (6) applicants for clerical jobs must make satisfactory scores on clerical aptitude and mental ability

tests; (7) employment practices among some of the industries were non-discriminatory for jobs in the professional and clerical major occupational groups, while employment practices among the other industries reflected community custom and habit; (8) the refusal of many craft and industrial unions to accept membership from Negroes promotes under-utilization of human resources; (9) in identical trade shop programs, conducted at Austin and Fulton High Schools, educational experiences were not comparable; (10) educational programs provided at Carson-Newman College and Knoxville College in curricula leading to industrial employment were found to be comparable; and (11) at the time that data were gathered for this investigation, vocational counseling services at all of the reported institutions were inadequate.

Microfilm \$2.75; Xerox \$6.00. 124 pages.

AN INVESTIGATION OF A SELECTED NUMBER OF BEGINNING FIRST GRADE CHILDREN'S FAMILIARITY WITH MEASUREMENT

(Order No. 61-3215)

George Leroy Mascho, Ed.D.
Indiana University, 1961

Chairman: Dr. Ronald C. Welch

Statement of the problem. The study was concerned with the problem of ascertaining beginning first grade children's familiarity with measurement and in determining whether certain selected variables had any affect on this familiarity. The study was limited to consideration of the following variables: sex, chronological age, socioeconomic status, attendance or non-attendance in kindergarten, and mental ability as measured by a readiness test. Each of these variables was then divided into subgroups. The measurement items investigated were limited to those found on the interview record form.

Procedure and methods. The scope of the study was limited to 150 beginning first grade children who were attending two large public school systems in Indiana. Three schools were used in each system. All of the children in the chosen schools were used in the study except those who were repeating the first grade or had repeated kindergarten, two children who were absent during the interview time and follow-up time, and one child with whom rapport could not be established.

The technique used for gathering the data for this investigation was the personal interview. Each child was interviewed by the author. The interview guide used was The Test of the Pre-School Child's Familiarity with Measurement devised by Josephine MacLatchy and Cecil Swales and adapted and expanded by the author. All of the interviews were completed by the end of the first month of school of the fall semester, 1960.

The data were placed on IBM cards so that the following statistical analyses could be made on the 650 electronic computer:

- An analysis of variance with each variable group.
- A t test between the means of each possible combination of the subgroups of the selected variable groups.

c. Percentage of correct responses of each item for the total group interviewed.

d. Percentages of correct responses of each item for the subgroups within the selected variable groups.

Major conclusions. On the basis of the findings of the present investigation, for the population tested and within the limits of this study, the following conclusions were drawn:

1. Age seemed to contribute to the child's familiarity with measurement with the younger children being less familiar with the measurement items than were the older children.

2. Socio-economic status seemed to contribute to the child's familiarity with measurement with the lower socio-economic status child being less familiar with the measurement items than were the middle or upper socio-economic status children.

3. Mental ability as measured by a readiness test seemed to contribute to the child's familiarity with measurement with the children in the low mental ability group being less familiar with the measurement items than were the children of the higher mental ability groups.

4. Sex and attendance or non-attendance in kindergarten did not appear to contribute to the child's familiarity with measurement.

5. There seemed to be a wide range in the child's familiarity with measurement. The range was from 22 to 84 items answered correctly. The familiarity with measurement was greater when used in context than when treated as isolated factual situations.

6. Children seemed to be more familiar with money than any other area of measurement.

7. The present investigation found children less familiar with measurement than previous studies indicated.

Microfilm \$2.75; Xerox \$7.60. 161 pages.

A STUDY OF ACADEMIC POTENTIAL AND ACHIEVEMENT IN PRESTIGE RATED FRATERNITY GROUPS AS COMPARED WITH DORMITORY RESIDENTS AND OFF-CAMPUS STUDENTS

(Order No. 61-3216)

Robert Edward Matson, Ed.D.
Indiana University, 1961

Chairman: Dr. Kate H. Mueller

One of the unique aspects of the American college campus is the social fraternity system. Fraternities are private associations located on the campus, hold real estate and other valuable property, often have long backgrounds closely interwoven into the past and present life of the college, and have traditional programs and methods of operation which are frequently outside the control or effective influence of the college administration and faculty. As a sub-cultural group within the institution of higher education, the relationship of fraternity membership to the motivation and achievement of its student members is of concern to educators in general and student personnel administrators specifically.

This research attempted to answer certain questions concerning the academic potential and achievement of

various housing groups at Indiana University. Three groups of ten fraternities each, ranked according to their local prestige, a residence hall group, and an off-campus group were analyzed. For these five groups the specific areas of concern were differences in the academic potential of student members, in achievement by members of similar ability, in group patterns of accomplishment, and in drop-out rates. The grades of first semester freshmen pledges were also compared to those who pledged after their first semester.

The sample used in this study included 1,181 male students who entered Indiana University as freshmen in the fall of 1954. Each of these students was placed into one of four academic potential levels on the basis of their high school records and orientation test scores. Group differences were tested by use of the chi square technique in a simultaneous comparison of all five campus groups over all four of the academic potential levels. For significant chi square values, each of the campus groups was compared on a one-to-one basis.

The following conclusions were drawn from the findings of this study:

1. Significant differences were found to exist in several respects between those student groups studied. These differences are worthy of special attention by the student personnel administrator.

2. The high prestige fraternities (Group I) had students of higher academic potential when the total group membership was compared with that of the other four groups. However, the over-all academic potential in the residence hall group was only slightly less than that of Group I during the junior year. Over the freshman, sophomore, and junior years, the middle prestige fraternities and the residence hall group had approximately equal groups with regard to over-all academic potential. These two groups were potentially superior academically to both the off-campus and low prestige fraternity groups over the first three of the four years studied. The low prestige fraternities (Group III) and the off-campus group were about equal with regard to over-all academic potential during these first three years. During the senior year, no substantial differences existed in the over-all academic potential between the five campus groups.

3. When the academic achievements of the high potential students were compared, Group I, Group II, and the residence hall group showed a tendency to achieve higher grade averages than Group III (low prestige fraternities) and the off-campus group. However, these differences were not statistically significant with the exception of the very high achievement by Group I in the first semester.

4. Membership in any of the five groups studied did not have an observable relationship to the achievement of the low-average and low potential students. However, there was a tendency at all four academic potential levels for members of the high prestige fraternity group to achieve comparatively high grades in the first semester.

5. The percentage of students who dropped out of school at each of the four potential levels showed that a much higher proportion of the students in the three fraternity groups remained in school as compared with the residence hall and off-campus groups. At the high, high-average, and low-average academic potential levels, the low drop-out rates among the three fraternity groups were significantly different from the high drop-out rate among the residence hall and off-campus students. Also, the drop-out

rates for Group I was considerably lower than that of Group II and Group III at these top three academic potential levels.

6. No consistent trends nor significant differences were found to exist between the grade achievements of first, second, and third semester pledges at any of the four academic potential levels.

Microfilm \$2.75; Xerox \$7.20. 153 pages.

**A COMPREHENSIVE ANALYSIS, CLASSIFICATION,
AND SYNTHESIS OF RESEARCH FINDINGS
AND THOUGHT IN THE AREA OF OFFICE
PRACTICE INSTRUCTION, 1951-1959.
(VOLUMES I AND II).**

(Order No. 61-3221)

Lena Voncille Burrell Prewitt, Ed.D.
Indiana University, 1961

Chairman: Dr. Elvin S. Eyster

The Problem

The problem is a comprehensive study of research findings and thought in professional (nonresearch) literature pertaining to the area of office practice instruction for the period 1951-1959.

The Procedure

Data were collected from original copies of research reports and from professional (nonresearch) literature that was related to the research findings. Abstracts of 124 research reports were prepared. The research findings taken from the 124 abstracts were studied and classified into seven major classifications. Thought obtained from excerpts and/or notes taken from 287 articles of professional literature was classified under the seven major classifications into which the research findings fell. Data included in each major classification were studied and a synthesis was prepared. The report was organized into three parts--synthesis, master list of sources of data, and abstracts of research reports--and presented in two volumes.

Findings

The research findings fell into the following classifications: history of office practice instruction, general characteristics of the office practice program, objectives and subject matter, class organizational plans and teaching methods and aids, classroom facilities and layout, student selection and evaluation, and automation in the office.

Since its inception as a single course in the business curriculum in 1898, office practice instruction has expanded in scope from the narrowly restrictive role of providing terminal education for secretaries to the more comprehensive role of providing terminal education of a broader nature, meeting the needs of those students preparing for secretarial positions as well as those preparing for clerical positions and positions in which the operation of office machines other than the typewriter is the chief

duty. At present, office practice instruction occupies a place in the business curriculum as a separate integrating program for students preparing for office employment. The component parts of the program are secretarial practice, clerical practice, and office machines instruction. Secretarial practice is designed for students with the ability to take and transcribe shorthand notes. Clerical practice is designed for students who do not possess the necessary potentialities or interest to take and transcribe shorthand notes. Office machines instruction is considered "core" instruction for secretarial and clerical practice. Clerical practice received more attention in both research and nonresearch literature than any other aspect of the office practice program during the period of time covered by this study.

Objectives, subject matter, and classroom facilities were more thoroughly investigated than any other aspect of office practice instruction. While much research was devoted to teaching methods, class organizational plans, and evaluation, many of the research studies lacked depth, breadth, and thoroughness, as evidenced by the research reports. Laboratory layout, history of office practice instruction, and the effects of automation on office practice instruction, received least attention from researchers.

A Concluding Statement

The research reports on which this investigation was based were descriptive-survey, historical, or experimental. Some of the studies were thorough investigations, whereas others were weak in certain respects. With a few exceptions, the professional literature was characterized by much repetition. The recorded research findings and professional thought may be useful to teachers and school administrators in improving office practice instruction, provided the limitations of the findings and thought are borne in mind. The research findings and professional thought, however, are perhaps most useful to (a) curriculum builders in constructing courses of study and initiating an office practice program in the curriculum and (b) beginning office practice teachers.

Microfilm \$6.10; Xerox \$21.60. 477 pages.

**AN APPLICATION OF EVALUATIVE CRITERIA
TO THE GRADUATE BUSINESS EDUCATION
CURRICULUMS OF SELECTED
SOUTHEASTERN INSTITUTIONS**

(Order No. Mic 61-2875)

Hollie Wilks Sharpe, Ed.D.
The University of Tennessee, 1961

Major Professor: Earl M. Ramer

Purpose

The purpose of this study was to apply an approved set of evaluative criteria to graduate business education curriculums of eleven selected institutions served by the Southern Business Education Association. The three sub-problems were: (1) to select criteria prior to 1953; (2) to develop and approve additional criteria based on

literature since 1953; and (3) to develop instruments and procedures for the application of the accepted criteria.

Procedures

Check lists of twenty-six criteria were mailed to twenty business educators in the United States, excluding those states in the Southeastern region. The seventeen persons who returned their completed check lists became the jury. An interview guide was developed from the sixteen criteria which received the approval of two-thirds of the jury members. Data for this study were secured through personal interviews with representatives of each of the eleven selected institutions located in the following states: Florida, Kentucky, Louisiana, Mississippi, North Carolina, Tennessee, and Virginia.

After the data were secured, the criteria were organized into four areas: (1) objectives and grade requirements; (2) curricular offerings; (3) requirements of instructional personnel; and (4) methods of instruction.

Conclusions

The institutions, understandably, did not meet the standards of all criteria equally well. Hence, the findings are presented under three categories: (1) criteria well met; (2) criteria acceptably met; and (3) criteria doubtfully met. The criteria are rephrased in the conclusions.

Criteria well met. The institutions collectively met the criteria summarized under this heading with a high degree of acceptance.

1. Ten of the eleven institutions made provisions for independent study of special problems in business education.

2. A master's degree in business education could be earned at each of the eleven institutions without knowledge of a foreign language.

3. Each institution provided a strong education department.

4. At least two-thirds of the selected institutions could be classified as multi-purpose in nature.

Criteria acceptably met. Criteria summarized under this heading were met with a minimum degree of acceptance.

1. Teaching loads of graduate instructors were normally three hours less than the loads of undergraduate instructors.

2. Each graduate representative felt that his students' teaching abilities had improved as a result of graduate study.

3. A "B" average or better was required for graduation at ten institutions.

4. These six areas of instruction were included in the graduate business education curriculums of seven institutions: principles and problems in business education; advanced teaching methods; curriculum construction in business education; administration, organization, and supervision of business education; special problems; and seminars in current problems and research.

5. Each institution provided some services for groups outside the institution itself.

6. The eminence and competencies of the graduate business education faculty met at least a minimum degree of acceptance.

7. Graduate instruction was characterized by seminars, guided discussions, and individual conferences designed for the development of independent thinking and the ability to solve problems.

8. The seminar method was used in courses dealing with the development of principles and problems.

Criteria doubtfully met. Collectively, the selected institutions failed to meet the minimum requirements of three criteria.

1. No English proficiency tests were used to determine ability in written expression either before beginning or after completing graduate study.

2. Limited opportunities were provided students for taking graduate content courses in business administration outside the fields of accounting, economics, and management.

3. Provisions for in-service conferences in business education were limited except during the summer sessions.

Microfilm \$2.75; Xerox \$8.40. 181 pages.

A DESCRIPTIVE STUDY OF THE ACADEMICALLY AVERAGE HIGH NINTH GRADE AND HIGH EIGHTH GRADE STUDENTS AT LANIER JUNIOR HIGH SCHOOL DURING THE SCHOOL YEAR 1959-1960, AS REVEALED BY RECORDED SCHOOL DATA.

(Order No. 61-3005)

Richard Dean Slater, Ed.D.
University of Houston, 1961

This study has been conducted and reported as descriptive research. It has described the average "C" student from the recorded school data in a particular junior high school during a limited period of time.

Descriptive data were collected from the following school records: 1) Houston Public School Permanent Record Card--residence, date of birth, sex, grade in school, and academic grades earned in each of the major academic subjects for each of the grading periods from seventh grade through the ninth grade, inclusive; 2) Standardized Test Record Card--intelligence quotient from the Otis Quick-Scoring Mental Ability Test, New Edition, Beta Form Em, grade equivalent scores secured on each of the tests (Paragraph Meaning, Word Meaning, Spelling, Language, Arithmetic Reasoning, and Arithmetic Computation) contained in the Stanford Achievement Test, Partial Battery, Advanced Form Km.

Data were recorded and total over-all grade point averages were computed for each of the 632 students for whom there were complete data. The 212 students selected for this study were those high eighth grade and high ninth grade students having a total over-all grade point average of "C", 1.50 to 2.49, inclusive. The group studied was composed of 90 high ninth grade and 122 high eighth grade students.

Data were processed and findings were arranged in three-dimensional tables (total major academic subject averages, standardized tests results, and sex). The data in each table were interpreted according to a common format: 1) range of scores; 2) sex differences;

- 3) total grade point average and intelligence quotient; and
- 4) summary.

To indicate socio-economic factors in relation to the students in this study, a base map of the Lanier Junior High School District was constructed. This base map was divided into wealth zones which were indicated by color. The residence of each student in this study was then plotted on two over-lays.

Descriptive findings were reported for each of the grade levels included in this study and for the composite group. Findings revealed that academically average students cannot be characterized by: 1) sex; 2) any definitely reliable intelligence quotient range; 3) any specific grade equivalent score or range of scores on standardized measures of academic achievement; 4) any strong preferences toward specific subjects; or 5) socio-economic area of residence.

The descriptive findings emerging from this study indicated that the all-inclusive factors generally employed in depicting academically average junior high school students are without supportive data. The wide ranges found for each factor studied and the variations from factor to factor indicate the presence of variability and individual differences among academically average students. The "average student" exists, but only as a mental image useful in describing a student when time or lack of information does not encourage a more careful examination of all the recorded descriptive data in school records. The average junior high school students appear to be relatively unknown and neglected students.

This has been a descriptive service study that has established limited base-line findings on the academically average students in one particular urban junior high school.

The need for additional studies has been anticipated by recommendations related to the use and improvement of school records, the image held of the average student, and uses of school data on the average student.

Microfilm \$2.75; Xerox \$8.40. 184 pages.

THE RELATION OF AUDITORY DISCRIMINATION AND INTELLIGENCE TEST SCORES TO SUCCESS IN PRIMARY READING

(Order No. 61-3228)

Bertha Boya Thompson, Ed.D.
Indiana University, 1961

Chairman: Leo C. Fay

Problem

This was a longitudinal study primarily to determine the relation of auditory discrimination (AD) and intelligence test scores to success in primary reading. Secondary problems were: (1) to determine whether children make significant improvement in auditory discriminative ability while attending the first and second grades; (2) to determine whether poor readers in primary reading establish a pattern on the 12 subtests of the Wechsler Intelligence Scale for Children (WISC) which might be significantly different from a pattern established by good readers.

Sources of Data

Of the 114 first grade entrants in the two elementary schools of Oxford, Ohio, in September, 1958, 105 completed the tests in May, 1960, and became the sample for this study. Their chronological age mean was 6 years 4 months when the initial AD tests were administered and 8 years 0 months when the final tests of AD and reading achievement were administered. The mean was 7 years 4 months when the WISC was administered. The mean I.Q. scores were 98.40 (S.D. of 11.60), 103.21 (S.D. of 14.56), and 100.24 (S.D. of 14.69) respectively on the Verbal, Performance, and Full Scales.

These tests of auditory discrimination were administered: A Test for Auditory Discrimination, Form A, by Wepman, Boston University Speech Sound Discrimination Picture Test, and Auditory Discrimination and Orientation subtest of the SRA Reading Analysis: Aptitude, Form A. An arbitrary scaling method was used to determine the adequacy of auditory discriminative ability of each individual.

Two measurements of reading achievement were used: Gates Advanced Primary Reading Test, Type AWR (Word Recognition), Form 1 and Type APR (Paragraph Reading), Form 1. Two criteria for determining Good Readers and Poor Readers were established: Criterion 1 included those 24 who placed at either end of the composite reading distribution; Criterion 2 included those 24 whose R.A.'s most greatly exceeded their M.A.'s and those 24 whose M.A.'s were higher than their R.A.'s.

Findings and Conclusions

The AD and intelligence test scores correlated highly with reading achievement scores, and the intercorrelations were significant. Correlations and intercorrelations varied from .414 between AD and Performance I.Q.'s to .656 between AD and Word Recognition.

A significant difference was found between the mean test scores on the initial and final measurement of AD and indicated improvement. The ratio of adequacy-inadequacy in AD was 29.5 to 70.5 per cent when this sample entered first grade; at the end of the second grade it was 76.2 to 23.8 per cent respectively. Approximately one-half of those inadequate in the latter ratio were Poor Readers.

Mean differences of the Good Readers and Poor Readers of Criterion 1 in AD test scores were significant. Their adequacy-inadequacy differences were also significant. However, for the Good Readers and Poor Readers of Criterion 2, differences were not significant.

Mean test scores of the Good Readers of Criterion 1 on the 12 WISC subtests were significantly higher than those of the corresponding Poor Readers except on Coding. The Poor Readers of Criterion 2 scored above all the subtest means of the corresponding Good Readers; however, the difference was significant on only Similarities and Picture Arrangement.

Intelligence and AD are highly correlated with success in primary reading, and adequacy in one trait is frequently accompanied by adequacy in the other in first grade entrants. However, high intelligence and AD scores are prognostic in determining only those who will place at the upper end of the reading distribution but not those who will

achieve a R.A. above his M.A. Inaccurate auditory discriminative ability is more characteristic of first graders than accuracy. The reverse is true for those completing the second grade.

Microfilm \$2.75; Xerox \$7.00. 147 pages.

EDUCATION, ADMINISTRATION

THE INTERNAL ADMINISTRATIVE ORGANIZATION OF THREE-YEAR JUNIOR HIGH SCHOOLS

(Order No. Mic 61-2523)

Robert Thomas Brunner, Jr., Ed.D.
University of Southern California, 1961

Chairman: Professor LaFranchi

The purpose of this study was to determine what should be the internal administrative organization for a junior high school.

Data for the study were obtained from a survey form completed by 64 per cent of the principals of three-year junior high schools in California and forty-eight principals in other states. Standards for administrative organization were determined by another survey completed by twenty-two specialists in junior high school and/or personnel administration.

Findings. (1) The certificated nonteaching staff-pupil ratio increased as the schools increased in size. (2) Certificated staff members were allotted to schools on a definite basis or ratio in most school districts. (3) There was very little agreement regarding titles of staff members except for the title of "principal." (4) No pattern of administrative organization was reported frequently enough to say that it was typical. (5) Schools in California placed a heavy reliance on part-time counseling. (6) Certificated nonteaching staff members were directly responsible to the principal with very few exceptions. (7) Principals retained responsibility for most management functions, in-service training of teachers, evaluation of teacher growth, master schedule, curriculum work, provision of instructional materials, and student body finances. (8) Very few principals retained responsibility for services in the area of counseling and guidance. (9) Certificated nonteaching staffs were far below the numbers recommended by the specialists.

Conclusions. (1) Small schools should have smaller staff-pupil ratios than large schools. (2) Certificated and clerical staff members, too often, are not allotted to schools on a clearly stated, written ratio or factor basis. (3) Principals are not sufficiently concerned with the need to use similar titles for persons who perform similar services. (4) There is no optimum administrative staff pattern for all junior high schools. (5) Principals are not doing an adequate job of delegating responsibility. (6) Principals are concerned about the adequacy of their counseling and guidance program, and would like to expand these services in their schools. (7) Principals are not suffi-

ciently concerned with the administrative organizational pattern of their schools. (8) There is considerable confusion regarding the organization of the guidance program, especially regarding the question of full- or part-time counselors.

In addition to the conclusions listed above, a set of criteria based on the practices reported, evaluate statements made by the principals, and the standards recommended by the specialists was presented.

Recommendations. (1) Principals should evaluate their administrative organization frequently in the light of the criteria established in this study, the principles of organization, and the needs of their communities. (2) Principals should utilize the certificated nonteaching and clerical staff titles outlined in the study. (3) Principals should delegate responsibility for more services so that they can have time to exercise leadership for the whole school and give a more balanced amount of attention to the three areas of management, instruction and curriculum, and counseling and guidance. (4) The administrative organization and the services provided by each member of the staff should be written in chart form and be made available to all staff members. (5) The school district should allot certificated and clerical staff members to schools on a clearly stated, written ratio or factor basis.

Microfilm \$3.65; Xerox \$12.85. 282 pages.

THE RELATIONSHIPS BETWEEN EIGHT SITUATIONAL FACTORS AND HIGH AND LOW SCORES ON THE LEADERSHIP BEHAVIOR DIMENSIONS OF INSTRUCTIONAL SUPERVISORS

(Order No. 61-3330)

Ona Lee Campbell, Ed.D.
North Texas State College, 1961

The problem with which this study is concerned is that of determining the relationships between eight situational factors and each of the two behavior dimensions of Consideration and Initiating Structure of instructional supervisors. The leader behavior of forty instructional supervisors is described by 356 teachers. These same teachers describe the situational setting in which such behavior takes place. The supervisors also describe the situational factors involved in such leadership action. The supervisors also provide a personal profile to give scores on certain personality traits as one factor in the study.

The purpose of the study was to determine the extent to which relationships exist between each of eight situational factors and the behavior dimensions of Consideration and Initiating Structure scores of the supervisors studied. The determination of the level of significance of any correlations found to exist was also a part of the purpose of the study. Eight null hypotheses were set up and tested for significance. In addition to determining the coefficients of correlation for these relationships, the difference of the means when the supervisors were categorized into upper and lower one-third groups on the basis of scores on each of the two behavior dimensions was calculated and tested for significance.

Coefficients of correlation and levels of significance are given for thirty-two relationships between behavior dimensions and situational factors. Nine of the coefficients of correlation are statistically significant at the .01 level, two at the .05 level, and the remainder above the .05 level.

The difference of the means when categorized into upper and lower one-third groups on the basis of scores on each of the two behavior dimensions is given for the situational factors studied. These differences of means and levels of significance are given for thirty relationships. Ten of these differences of means were significant at the .01 level, two at the .05 level, and the remainder at above the .05 level.

Of the eight null hypotheses concerning relationships between the behavior dimension of Consideration and the eight situational factors, five are rejected, two are accepted, and one is accepted with limitations. In the relationships between the behavior dimension of Initiating Structure and the situational factors, two hypotheses are rejected and six are accepted.

This report concludes that the behavior description instrument used in the study does discriminate between leader behavior of instructional supervisors. It is further concluded that teachers value highly those behavior actions of supervisors which tend to signify warmth, mutual trust, friendship, and respect. It supports the theory that leadership adequacy is related to the demands of the situational factors in which the action of the leader takes place.

Among the situational factors found to be significantly correlated with scores on the behavior dimension of Consideration are the number of years of classroom experience of the supervisor, participation of teachers in determining the supervisory problems worked on, and concept of leadership adequacy.

Knowledge of and understanding of the relationships that exist between supervisory leadership and the many situational factors found in the social setting in which supervision takes place is recommended as a primary area for concentration of efforts by designers of pre-service and in-service education programs.

Microfilm \$2.75; Xerox \$7.20. 153 pages.

A SURVEY OF THE PUBLIC RELATIONS PROGRAMS IN SELECTED SCHOOL SYSTEMS

(Order No. Mic 61-1965)

Vicente Antonio Colon, Ph.D.
The University of Nebraska, 1961

Adviser: Leslie L. Chisholm

School public relations require cooperation in planning and working for good schools. If the people in a democracy are to have a part in the making of school plans and decisions, they need to be given accurate and ample information.

The Problem

The problem undertaken in this study is to discover by survey and analysis the nature and merits of the

public relations programs in certain schools in Nebraska.

The problem may be further delineated by subdividing it as follows: (1) to ascertain what procedures are being used by the schools to give information to the public, (2) to determine the nature and scope of the public relations activities the schools use in interpreting their programs to the community, (3) to determine the extent to which the people of the community participate actively in the planning of the school program, particularly as it relates to the public relations of the school.

The Procedure

In order to study the public relations programs of certain schools in Nebraska, a personal interview was held with a selected number of school officials in eight school systems. In order to broaden the scope of the study beyond that of the personal interviews, a questionnaire was submitted to administrative officials of thirty-six Class III schools.

In addition, twenty-five laymen, maintenance and custodial personnel, and staff members were interviewed concerning their relationship to the school and its administration.

Conclusions

Certain conclusions were reached concerning the public relations procedures being used by the schools, the nature and scope of the public relations activities the schools use in interpreting their programs to the people, and the extent to which the people participate actively in the program.

The following are the chief conclusions reached:

- (1) The inquiry revealed that only a few of the schools studied are utilizing in any comprehensive manner the recommended devices and techniques to interpret the school to the community.
- (2) The majority of the public relations programs examined were unorganized or casually organized, sporadic in nature, poorly planned, and equally poorly executed.
- (3) Those schools which are using recommended practices and activities for the improvement of their public relations programs find them advantageous and worthwhile.

Recommendations

On the basis of the findings and conclusions, recommendations were made for the improvement of the public relations programs of the schools in the study. The major recommendations are as follows and are only representative of those presented in the study itself:

- (1) Schools should consider the feasibility of hiring a trained public relations person to direct the public relations program of the school.
- (2) Every member of the staff, instructional and non-instructional, should be appraised of the philosophy and objectives of the school and of his contribution to the public relations program.

- (3) Teacher-training institutions should give added emphasis to the values of a public relations program in terms of the school as well as the teacher himself.
- (4) Schools should conduct a periodic evaluation of the public relations program with a view at improving it. Microfilm \$2.75; Xerox \$9.45. 209 pages.

THE "DISTRIBUTION OF POWERS" AND THE ORGANIZATIONAL STRUCTURE OF EDUCATION

(Order No. 61-2996)

Floyd Gurney Delon, Ed.D.
University of Arizona, 1961

Supervisor: Lloyd E. McCann

The Problem

The problem of the present study is to analyze the influence of the legal principles derived from the classification and distribution of governmental powers on the organizational structure of education. The principles examined in this study include: (1) the allocation of powers among national, state, and local governmental units, (2) the doctrine of separation of powers, (3) the principle which forbids the delegation of legislative power by the legislature and discretionary authority by public officers, boards, and commissions.

Method of Investigation

This investigation is based on the body of national and state court decisions in which application of the principles of distribution of powers are made. Background for the decisions based on antecedent philosophical and theoretical treatises in government and education has been supplied. The study was conducted using the technique of documentary analysis characteristic of legal research.

Origin of the Problem

The problem of the present study grew out of a recognition that the organizational structure of education, as an integral part of government, is affected by legal principle and political theories, on one hand, and tradition and practice on the other. Because of the magnitude of an investigation encompassing all these facets, this study is limited to one area of legal influence: the distribution of powers.

Findings and Conclusions

Allocation of Educational Responsibility. After being firmly established in the nineteenth century as an attribute of state government, legal sovereignty over education now appears to be shared concurrently by state and national government. This re-allocation of responsibility resulted from restrictions being placed on the states by new interpretations of the Fourteenth Amendment and by federal legislation under the "common defense and general welfare" clause.

Governmental cooperation in providing public education has developed not only between state and national government but also between state and local government. The courts of a few states have said that local authorities may enact any regulation affecting education which does not conflict with state policy.

Separation of Powers and Education. The relationships controlling governmental operation generally, which have developed under the doctrine of separation of powers, are applicable to the exercise of the governmental function of education. Although the legislative department is primarily responsible for over-all educational policy-determination, a great deal of discretion must be left to administrative bodies in the implementation of this function. The courts, upon which the responsibility for preventing interdepartmental encroachment has devolved, perform policy-determination indirectly through judicial review of legislative enactments and administrative acts. Thus, the state legislature shares its educational authority with not only other levels of government but also with the coordinate departments.

Delegation of Educational Authority. The legislature has been further restricted in the exercise of its authority over education by limitations on its power to delegate educational responsibility. There is a wide variation among the states in the interpretation and application of the non-delegation principle. A statute delegating authority may be attacked constitutionally in one state and directly in another. In general, the determination of what functions may be delegated and to whom they may be delegated is dependent upon the attitude of the courts of a particular state. Once legislative authority has been delegated by the legislature to the school board or other agency, the agency must exercise this discretion and may not sub-delegate it.

Recommendations

The differences in educational opportunity within a given state and among several states, plus new demands placed on the schools of the nation, point to a need for the re-evaluation and improvement of the organizational structure of education. In the past, the allocation of powers has served to maintain a great deal of state and local control over education; the doctrine of separation of powers has resisted the shift of over-all educational policy-determination from the legislative branch of government; the non-delegation principle has prevented arbitrary and capricious acts by educational administrators in certain instances. However, where the "distribution of powers" stands as a barrier to progress, it should be removed by legislation, by judicial interpretation, or (if necessary) by constitutional amendment.

Microfilm \$3.15; Xerox \$10.15. 244 pages.

A COMPARATIVE ANALYSIS OF THE
FUNCTIONS OF SPECIALISTS IN THE
COOPERATIVE EXTENSION SERVICE, BY
BROAD SUBJECT AREAS.

(Order No. 61-3111)

John Jackson Harvey, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Gale L. Vande Berg

The over-all purpose of this study was to determine the degree to which the accepted generalizations about functions of all specialists apply to specialists in particular subject-matter fields. A primary objective was to determine differences in the perceptions of specialists by broad subject-matter areas with respect to clientele served, functions performed, hindrances encountered and concepts of over-all role.

Data were collected from 211 extension specialists in six states. Specialists were classified into five groups based upon the nature of their work and the clientele they serve. The data were analyzed and interpreted on the basis of this classification.

Summary

The hypothesis that specialists' perceptions regarding major clientele served vary according to the specialist's subject-matter field was accepted. There were distinct differences among specialist groups with respect to (1) clientele currently being served and (2) clientele that should be served.

The hypothesis that major functions of specialists vary according to the specialist's subject-matter field was accepted. Although there was general agreement by specialists in all groups with regard to seven functions classified as major and nine functions classified as minor, considerable variation existed by specialist groups regarding other functions.

The hypothesis that obstacles specialists recognize as major hindrances in the conduct of their work differ according to the specialist's subject-matter field was accepted. There were very decided differences among specialist groups with respect to hindrances identified.

The hypothesis that specialists' concepts as to what the primary roles of specialists are and should be vary according to the specialist's subject-matter field was accepted. There were variations among specialist groups in the roles currently being performed. There were also distinct differences in the perceptions of specialists, by broad subject area classification, as to what should constitute the primary role of specialists.

In order to meet the demands for more specialized work, Extension has created positions in new subject areas and has increased specialist personnel in many of the established subject areas. Because of the nature of these subject areas and the clientele served, specialists in many of the new positions are finding that traditional approaches to specialist work are no longer appropriate.

This study provides clear evidence that generalizations cannot be made to the effect that extension specialists constitute a homogenous group. Specialists' work may be impeded unless differences are recognized and personnel

management and administrative policies and procedures are developed accordingly.

Microfilm \$2.75; Xerox \$7.60. 162 pages.

THE RELATIONSHIPS BETWEEN TEACHER
MORALE AND THE ABILITY TO ESTABLISH
RAPPORT WITH PUPILS AND
OTHER SELECTED VARIABLES

(Order No. 61-3332)

Thomas Barlow Hill, Jr., Ed.D.
North Texas State College, 1961

The problem with which this investigation was concerned was that of determining the relationships which exist between teacher morale, as measured by the Group Dimensions Descriptions Questionnaire, and teacher-pupil rapport, as measured by the Minnesota Teacher Attitude Inventory, and other selected variables.

In the course of the study, 374 public school teachers were secured from thirty-three schools selected in stratified random sampling from the Dallas metropolitan area. The schools were grouped according to size (small, middle-size, and large) and organizational level (elementary, junior high, and senior high). Each school was visited and the instruments selected for the study were administered to as many teachers as were made available, with a minimum of 50 per cent participating.

After the problem and its scope were outlined, it was deemed necessary to survey and analyze the psychological concepts of morale and teacher-pupil rapport, and also to examine the rationale and development of the Group Dimensions Descriptions Questionnaire and the Minnesota Teacher Attitude Inventory. The psychological construct of morale was found to be only moderately well established in professional literature. While exact definitions vary, there seemed to be general acceptance that (1) morale is not static but dynamic, (2) that it consists of several components, and (3) that it can be measured, although much refining of instruments and techniques is needed.

The data which were assimilated from the instruments were processed through the IBM "704" computer. Coefficients of correlation were calculated to test the null hypothesis that no significant correlation exists between teacher morale and teacher-pupil rapport. The result was a correlation of .274, and the critical ratio of 5.21 resulted in a rejection of the null hypothesis at better than the .001 level of significance.

Analysis of variance, the F ratio, was utilized to determine the level of relationship between teacher morale and personal and professional characteristics of sex, age, marital status, religious affiliation, parents' vocation, teaching experience, annual salary, and education. The same statistic was also employed to calculate the significance of the relationship between teacher morale and school size, school organization, and school type (elementary only).

The results and levels of significance for teacher morale and the personal characteristics of teachers included: sex (.0658) not significant, age (.9777) not significant, marital status (.7060) not significant, religious

affiliation (3.9161) significant at the .01 level, and parents' vocation (.5497) not significant.

The results and levels of significance for teacher morale and the professional characteristics of teachers included: teaching experience (1.1254) not significant, annual salary (2.2525) not significant, and education (.4791) not significant.

The results and levels of significance for teacher morale and school characteristics were: school size (1.85) not significant, school organization (2.45) not significant, school size and organization combined (2.41) significant at the .05 level, and school type (elementary only) (11.47) significant at better than the .01 level.

There exists a vital responsibility on the part of personnel administrators to scrutinize closely the personality characteristics of prospective teachers and those in the school system to eliminate those mentally and emotionally unsuitable to work with pupils.

There exists a joint responsibility of faculty and administration continually to study and attempt to improve faculty morale. To this end it is recommended that outside personnel be brought in at appropriate intervals to study the morale situation and make recommendations. Teachers who have persistent difficulties should be counseled and assisted or dismissed.

Microfilm \$2.75; Xerox \$6.00. 123 pages.

A SURVEY AND APPRAISAL OF THE POSITION OF CITY SCHOOL SYSTEM PUBLIC RELATIONS DIRECTOR

(Order No. 61-3210)

John Eugene Hinton, Ed.D.
Indiana University, 1961

Chairman: Maurice A. McGlasson

The Problem: The purpose of the investigation was to survey and appraise the position of city school system public relations director. The study was designed to: (1) identify the persons responsible for city school system public relations programs, (2) identify the duties of such persons, (3) reveal the professional characteristics of the position of city school system public relations directors, (4) ascertain the training and background of the city school system public relations directors, (5) discover the emerging duty patterns of city school system public relations directors, (6) appraise the duty patterns of present directors and the organizational structure of their programs according to the principles of school public relations, and (7) derive conclusions and make recommendations in terms of the duty patterns and organizational structure that would be helpful to those involved directly or indirectly in initiating the new or improving the present city school system public relations program.

Procedure: A postal card survey was made of all city school system superintendents located in cities of 10,000 to 100,000 population in the geographical area of the North Central Association of Colleges and Secondary Schools. They were asked to indicate the person or persons responsible for the program of public relations in their school

systems. The survey revealed 42 directors of public relations who spent 50 percent or more of their time directing such a program. Thirty-two of those persons participated in the study. The public relations directors were sent a Public Relations Director Information Form in which they were asked to check: (1) personal and professional information, (2) educational background, (3) work experience, (4) organizational basis of their program of public relations, (5) the duties they performed as part of their program according to the categories of regularly, occasionally or never, (6) the value each duty had to their total program, and (7) the training they recommended for future public relations directors. The results of the survey were presented in table form according to frequency and degree of performance. As a final step the duty patterns of the public relations directors were appraised by the staff of the National School Public Relations Association in terms of the purposes of school public relations.

Conclusions: There was no uniformity of title given the persons responsible for city school system public relations programs. The public relations position was a newly created position in a majority of the systems in the study. The public relations position was primarily an administrative position with a majority of the duties encompassing either administrative or publicity duties. The school systems that had a special budget for public relations seemed to have the better public relations programs. Most city school system public relations programs had as a basis for the program the objectives of the system's educational program. The study revealed 21 duties performed regularly by a majority of the public relations directors in the investigation. The most pressing problems of the directors were problems of internal operation. The duty patterns of the 32 directors were in agreement with the purposes of school public relations as viewed by the staff of the National School Public Relations Association. Microfilm \$3.20; Xerox \$11.25. 248 pages.

RELATIONSHIPS OF PERSONAL VALUE SYSTEMS TO A MEASURE OF JOB SATISFACTION AMONG PERSONNEL OF THE FLORIDA AGRICULTURAL EXTENSION SERVICE

(Order No. 61-3626)

Emily Elizabeth King, Ph.D.
The University of Wisconsin, 1961

Supervisor: Alton C. Johnson

The purpose of this study was to reveal the direction of the relationships of personal value systems to job satisfaction among Extension personnel in the State of Florida.

Procedure

Personal value systems were interpreted to be the intensity of eight value areas as measured by the Poe Inventory of Values. The measure of job satisfaction was that which was developed by the author as part of the present investigation. This instrument was designed to elicit responses in each of eight areas of job satisfaction.

The development and analysis of the Extension Job Satisfaction Inventory were based on the responses of 220 Florida Extension workers. The final analysis was performed on the responses of 140 Florida Extension workers utilizing the data collected with three instruments; (1) The Poe Inventory of Values, (2) The Extension Job Satisfaction Inventory, and (3) Personal Data Form. In the analysis of these data, various statistical methods were employed.

Product-moment correlations were computed for each of the eight areas comprising the Poe Inventory of Values and the eight areas of the Extension Job Satisfaction Inventory, making a total of sixty-four intercorrelations.

The 140 respondents making up the final analysis group were classified and regrouped in four ways; (1) by job satisfaction, most and least, (2) by sex, (3) by position, state or county, and (4) by time devoted to doing primarily youth or adult work, more than 50 percent of time devoted to youth work or more than 50 percent of time devoted to adult work.

Analysis of variance with the t-test was employed in comparing the two groups within each classification for the purposes of testing the following four null hypotheses:

1. There is no significant difference between the value area scores of the most and least satisfied Extension workers.
2. There is no significant difference between the value area scores of men and women Extension personnel.
3. There is no significant difference in the value area scores of state and county Extension workers.
4. There is no significant difference between the value area scores of Extension workers doing primarily youth work and those doing primarily adult work.

Findings

Ten of the sixty-four intercorrelations of the eight value areas with the eight areas of job satisfaction were found to be statistically significant at either the one or five percent level. Seven of the ten correlations were in a positive direction and three were in a negative direction. The seven positive correlations were; (1) Aesthetic with Salary, (2 and 3) Social Contact with Salary and Profession, (4, 5, 6 and 7) Humanitarian with Salary, Profession, Personal Relations, Opportunities. The three negative correlations were; (1) Aesthetic with Administration and Organization, (2) Religious with Administration and Organization, and (3) Prestige with Living Conditions.

The data also showed that there was a statistically significant difference between the scores of the two groups within each classification in at least one value area. Therefore, the hypotheses of no significant differences in the value area scores of the two groups within each classification were refuted.

Significant differences were found to exist in four value areas:

1. Aesthetic--the women and youth workers had respectively higher scores than did the men and adult workers.
2. Power--the men and county workers had respectively higher scores than did the women and state workers.
3. Religious--in this area the women scored higher than the men, county workers higher than state

workers and youth workers higher than adult workers.

4. Humanitarian--the women scored higher than the men, the county workers higher than the state workers and the most satisfied workers higher than the least satisfied workers.

Microfilm \$2.75; Xerox \$7.00. 149 pages.

AN ANALYSIS OF SELECTED HUMAN RELATIONS FACTORS RELATIVE TO COUNTY PERSONNEL IN THE NEBRASKA COOPERATIVE EXTENSION SERVICE

(Order No. 61-3135)

Duane Evan Loewenstein, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Alton C. Johnson

Purpose and Objectives

This study was concerned with the assessment of knowledge, interest, attitude and skill in human relations of county personnel of the Nebraska Cooperative Extension Service. Relationships were determined between the human relations factors and population characteristics of the personnel and their job performance as rated by district extension supervisors.

These objectives were developed: (1) to determine differences between population characteristics among extension districts; (2) to determine relationships between population characteristics and job performance ratings; (3) to determine relationships between population characteristics and assessment of each instrument employed; (4) to determine relationships among extension districts on the basis of job performance and assessment of each instrument developed; and (5) to determine whether or not differences arise between extension districts in Nebraska due to understanding of human relations and practicing of human relations.

Methodology

The Nebraska county personnel (168) responded to (1) the Human Relations Survey--to assess knowledge of and interest in human relations, (2) Bills Index of Adjustment and Values--to assess attitudes toward human relations, and (3) a questionnaire requesting tenure, age, sex and college undergraduate major. The Nebraska Extension district supervisors rated the personnel on (1) Human Relations Performance--to assess skills in human relations, and (2) job performance rank-order.

In order to obtain these data, it was necessary to construct and test the Human Relations Survey and the Human Relations Performance instruments.

The data relevant to human relations of county personnel were analyzed, separately, according to (1) sex, (2) tenure, (3) age, (4) college undergraduate major, and (5) job performance rating. Statistical techniques employed included the chi square test, Pearson's Product-Moment Correlation Coefficient, Spearman's Rank-Order Correlation Coefficient, and Kendall's

Coefficient of Concordance. Reports of statistical significance represent either the 5 per cent or 1 per cent levels.

Summary of Findings

The data revealed these statistically significant relationships. As (1) tenure and (2) age increased, the personnel were rated higher on job performance.

There was a statistically significant difference in the distribution of personnel when classified by age and personality grouping of Bills Index of Adjustment and Values.

Statistically significant relationships were disclosed between Human Relations Performance scores of personnel and their (1) tenure, (2) college major, (3) job performance rank-order, and (4) job performance classified by high, middle and low categories.

The Human Relations Survey scores of personnel by district and sex were ranked and correlated separately, with their (1) job performance rank-order, and (2) ranked Human Relations Performance scores. In each comparison, only 2 of the 16 correlation coefficients were statistically significant.

When district supervisory team members (1) ranked personnel on job performance, and (2) rated personnel on Human Relations Performance, correlation coefficients were statistically significant between men and women supervisors for each comparison.

The reliability coefficient of the Human Relations Survey for the study population was .57. The reliability coefficients of the four districts ranged from .48 to .62; all were statistically significant.

The study of human relations is an extremely complex area. As research proceeds beyond the classification of personnel by groups, extension administrators and supervisors will have available to them principles and procedures for increased understanding of county personnel as individuals. Microfilm \$2.75; Xerox \$8.00. 172 pages.

A STUDY TO DETERMINE THE ADEQUACY OF TEXAS PUBLIC SCHOOL TRANSPORTATION SERVICE AND SUPPORT UNDER THE FOUNDATION PROGRAM ACT

(Order No. 61-3333)

Alfred Louis McGregor, Ed.D.
North Texas State College, 1961

This investigation is concerned with the problem of the evaluation of the Texas public school transportation program, using a recognized score card, and determining the degree of state support of the program.

The field study reports the utilization of direct questionnaires to the administrators charged with school transportation in fifty counties of the state.

The dissertation is organized into five chapters. The first gives the background and setting of the problem. Chapter II is concerned with the selection of the instrument adapted for the use of the survey. Chapter III records the results of the scoring, and Chapter IV gives the details of the financial situation in the various counties of the sample in connection with the school transportation

program. Chapter V summarizes the findings and conclusions, and lists the recommendations.

The study indicates that, based on the information supplied by the administrators reached in the survey covering fifty counties, the program attains 77.9 per cent of an ideal score. The two major areas of the score card which receive the lowest rating are shown to be Safety and Adequacy. The survey supplies information concerning finances which shows that costs of public school transportation exceed earnings from the state by an average of \$387.00 per bus. Forty-five of the fifty counties surveyed report more expenditures than state income for transportation purposes. Five counties indicate more state aid earnings than expenditures. Condensed, the report shows that 80.9 per cent of the cost of transportation for schools is supplied by the state.

Conclusions reached are that Texas public schools have a transportation program which fails to meet the abridged Isenberg standards (used in the survey) by 22.1 per cent; at the same time the state fails to support the program financially by 19.1 per cent.

The recommendations made are that a statewide study be made of the entire school transportation program, that an educational program be carried out on the subject of Safety, that an additional \$387.00 be paid per bus annually, and that Efficiency and Economy be improved in connection with school transportation in Texas.

Microfilm \$2.75; Xerox \$5.20. 105 pages.

THE ORGANIZATION AND ADMINISTRATION OF OFF-CAMPUS STUDENT TEACHING IN RELATION TO PROFESSIONAL LABORATORY EXPERIENCES IN SELECTED INSTITUTIONS OF GEORGIA

(Order No. 61-3217)

Walter Alexander Mercer, Ed.D.
Indiana University, 1961

Chairman: Dr. Ruth G. Strickland

Statement of Problem

This study sought to determine the organization and administration of off-campus student teaching in relation to professional laboratory experiences in selected institutions of Georgia. The major purposes of the study were: (1) to determine the professional training, duties and responsibilities of the directors of student teaching, (2) to analyze certain administrative practices and policies related to off-campus student teaching, (3) to determine the influence of the development of off-campus student teaching on selected aspects of teacher education in the institutions since the 1949-1950 academic year, and (4) to ascertain the degree of implementation of certain professional criteria proposed by the American Association of Colleges for Teacher Education in the programs of the selected institutions.

Source of Data

Data were obtained through personal interviews with the directors of student teaching in eight selected Negro institutions in Georgia.

Summary of Findings

Regarding the professional training, duties and responsibilities of the directors of student teaching. The years of service of directors of student teachers to their present institutions ranged from one to approximately 35 years. All of the directors had done work beyond the baccalaureate degree. None of the directors had had much experience in teaching, supervision or administration in elementary or secondary schools though they had a substantial number of years as college teachers. The institutions had, according to size and instructional organization, from one to 12 supervisors, each devoting varying amounts of time to the supervision of student teaching.

Regarding practices in conducting programs of off-campus student teaching. Practices with reference to the kind of contractual agreement existing between the colleges and cooperating schools differed, and also the content of the contractual agreement and the duration of the contract. The duties and responsibilities of directors of student teaching varied considerably and as did problems of distance to the cooperating schools.

Regarding the influence of the development of off-campus student teaching on selected aspects of teacher education since the 1949-1950 academic year. Some variation existed with reference to: the content of teacher education programs, use of educational resources, selection of teacher education personnel, philosophies of teacher education, amount of honorarium given to supervising teachers used in the supervision of student teaching, together with the subsidy arrangements and their sources, and also the criteria used for the selection of cooperating teachers, and the rank provided for them by the institutions.

Regarding the implementation of the professional criteria. Two criteria dealing with the purpose for student teaching and the provision of full time student teaching were fully implemented. Five criteria were substantially implemented: the point in the professional sequence at which student teaching occurs; the need for a conference between student teacher and cooperating teacher before the student teaching assignment is considered final; the adjustment of responsibilities to the needs, interests and abilities of the student teacher; the provision for participation in certain essential types of experiences; and laboratory experiences following student teaching. Eight criteria were moderately implemented: assignment based on cooperative study of student's needs and abilities; the basis to be used in determining the nature of student teaching activities; cooperative development of the nature and extent of the student teaching period; provision for guided contacts with differing abilities, maturity levels, and socioeconomic background; provisions of adequate supervision by college and cooperating teacher; provision for responsible participation in all phases of a teacher's activity, both in and out of school; bases for evaluation and methods of evaluating; and provision for first hand experiences with children, youth and adults in school, home and community situations. Two criteria dealing with provision for individual differences in number and length of student teaching assignments were not implemented by any of the institutions.

Conclusions

1. The selected institutions were aware of the professional criteria. Although the professional training, duties

and responsibilities of the directors of student teaching varied considerably, the institutions were working toward fuller implementation of the criteria. Some individual institutions needed to work toward implementing certain aspects of the professional criteria.

2. The influence of the development of off-campus student teaching on selected aspects of teacher education since the 1949-1950 academic year varied considerably regarding content, method, materials, philosophy of teacher education, and the amount of honorarium given to supervising teachers used in the teacher education program.

Microfilm \$3.40; Xerox \$11.95. 264 pages.

A STUDY OF FACTORS INFLUENCING COORDINATION OF RESIDENT-INSTRUCTION, RESEARCH, AND EXTENSION IN HOME ECONOMICS IN SELECTED LAND-GRANT INSTITUTIONS.

(Order No. 61-3157)

Marlys Ruth Richert, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Robert C. Clark

Purpose

The purpose of this study was to examine how Home Economics was organized in 1960 in the land-grant institutions and how the major branches were coordinated in three such institutions; namely, Iowa State University, Oregon State College, and Pennsylvania State University. The specific purposes were to explore the nature of coordination in Home Economics, the differences in degrees of coordination that exist in resident-instruction, research, and extension, and major factors that help to explain the differences.

Procedure

A mail questionnaire to Heads of Home Economics provided data to determine the organization of this subject matter field in the land-grant institutions in the fifty state, including the organization of Home Economics in the state Cooperative Extension Services. Data concerning the three selected institutions were collected through a pre-tested questionnaire and personal interviews. The questionnaire was administered to 150 staff members, consisting of extension specialists and staff members in resident-instruction and research in the same subject matter areas. Personal interviews were conducted with the administrative and supervisory personnel.

Results and Conclusions

Resident-instruction, research, and extension were the functional groups in the Home Economics Unit in only one-third of the land-grant institutions. Resident-instruction and research comprised the Unit in 58 per cent of the institutions.

Extension specialists were not members of the Home Economics Unit when it was a branch of Agriculture any more frequently than when it was an independent unit in

the institution. There were no formal ties between specialists and resident-instruction and research personnel by which subject matter was integrated in over half the institutions. There were very few formal ties between 4-H personnel and resident-instruction and research staff members.

The degree of coordination of the resident-instruction, research, and extension functions was related to the position of the extension specialists in the organizational structure of Home Economics. The degree of coordination was greatest when specialists were members of the subject matter departments. Coordination was also greater when specialists were unofficial members of the Home Economics Unit than when specialists were not part of the staff in the Home Economics Unit.

The degree of coordination was related to the degree of importance attached to coordination, to the kinds of administrative policies and procedures for effecting coordination, to the opportunities provided staff members in the three branches for joint planning and evaluation, and to the degree of mutual respect among the personnel in the three branches.

The position of the specialists as members of the subject matter departments was related to:

1. the extent to which resident-instruction and research staffs were informed on the extension program
2. the extent to which extension specialists were informed on the resident-instruction program
3. the extent of general agreement on consistent and appropriate subject matter for resident-instruction and extension programs
4. the opportunities afforded staff members to jointly discuss and evaluate resident-instruction and extension programs
5. the extent of reciprocal recognition of achievements in the three branches.

The position of the specialists as members of the subject matter departments was not related to the extent to which the extension specialists were informed on the research programs.

The extent to which staffs were well informed on the programs in the three branches was related to the degree of importance attached to coordination.

The extent to which resident-instruction and research staffs were informed on the 4-H Home Economics program was not related to the degree of importance attached to coordination.

The extent to which resident-instruction and research staffs were informed on the extension programs was related to the importance attached to specialists holding comparable degrees.

Microfilm \$3.35; Xerox \$11.70. 260 pages.

THE ORGANIZATION AND ACADEMIC FUNCTIONS OF THE FACULTY IN EDUCATIONAL UNITS IN NURSING IN SELECTED INSTITUTIONS OF HIGHER EDUCATION

(Order No. 61-3229)

Helen M. Thumm, Ed.D.
Indiana University, 1961

Chairman: Louis G. Schmidt

An examination was made of the organization and academic functions of faculties in educational units in nursing in universities which offer programs leading to the baccalaureate and master's degrees. Seven schools of nursing were selected for detailed study using an interview with a member of the faculty and perusal of faculty minutes, faculty handbooks, and whatever material in the school that seemed pertinent and was available. All schools were approved for full accreditation by the National League for Nursing and all offered three types of programs, for high school graduates with no previous preparation in nursing, for graduates from diploma or hospital schools of nursing, and for professional nurses who had a baccalaureate degree and wished to specialize in nursing service or nursing education.

The findings indicated considerable disparity in the organization of faculties. All schools had a faculty organization but the only commonality about membership was that all members of the instructional staff holding professional rank were members. Standing committees were the most common working groups of the faculty organization, the number ranging from 5 to 12 per school. There was no standard or criterion for departmental organization which was found in six schools but was not always designated as such. Three schools had substructures of the faculty which were unique to the particular institution. The ways in which faculties carried on their functions differed with the institution although schools of nursing freely utilized the student personnel services of the controlling university for their students.

Six institutions gave some status or recognition to staff members in community agencies used for field instruction. In three, selected staff members were given rank and faculty membership. Other methods of recognition included listing agency personnel in the bulletin of the school, associate membership in the faculty organization, and letters of recognition from the university.

The following conclusions were drawn from the findings:

1. Educational units in nursing have adopted the pattern of faculty organization which prevails in other schools and colleges of the university of which they are parts. Such factors as the size of the student body, the size of the faculty, the number and variety of programs offered, whether the school is a primary or subordinate unit seem unrelated to the type of faculty organization and the substructures in which faculties work.

2. Faculty members seem to spend a great deal of time in meetings during which relatively little action is taken. Committees and departments seem to be deliberating bodies but little policy making was evident.

3. Faculties seem content with their organizations and rarely question the ways in which they operate. This conclusion is based on the opinions of administrative faculty

members and therefore it is quite possible that a different conclusion would be made if the opinions of instructional faculty had been obtained.

4. The personnel in agencies used for field instruction have little opportunity to formally participate with faculty of the school of nursing in curriculum planning.

5. Academic functions are common to faculties in schools of nursing but the ways in which they are accomplished are quite diverse.

6. Faculty members do not engage in research as part of their task in the university.

7. The organization of faculties in schools of nursing follow in most respects the principles of organization and academic function indicated in the literature of higher education.

Microfilm \$3.00; Xerox \$10.60. 231 pages.

SEPARATION FROM THE TEACHING PROFESSION ON THE PART OF MASTER'S DEGREE GRADUATES FROM THE UNIVERSITY OF PITTSBURGH

(Order No. 61-3293)

Kolman Frank Toth, Ed.D.
University of Pittsburgh, 1961

The purpose of this study was to determine the status of teachers who received the Master's Degree from the University of Pittsburgh: who separated from the profession; to identify and classify the reasons given by teachers for separation from teaching; and to interpret the implications of teacher separation.

The Elements of the Problem were:

- Identification of teachers with Master's Degrees who had separated from the service.
- Determination of the status of this group which has left the teaching profession.
- Identification and classification of reasons for separation from the profession.
- Interpretation of the implications of teacher separation from the profession.

The normative survey method of research was used in this study.

The method of comparison used in this study was weighted averages. The interpretation given to weighted averages follows: (a) a factor receiving a weighted average of three or over was highly important to the group being discussed; (b) a factor receiving a weighted average of two was important to the group discussed; (c) a factor receiving a weighted average of one was less important; (d) a factor receiving a weighted average of less than one was of secondary importance; and (e) the exact point at which a factor was no longer important was difficult to determine. Any factor which has a weighted average greater than .50 was considered to be significant. The first divisions whose value was 1.00 or greater were considered as primary factors. The second division consisted of values between .50 and .99. These were secondary factors. The third division consisted of those whose weighted averages were .25 or less and were considered to be unimportant factors in separation. Numerical values were assigned according to the degree of importance for each reason for separation. To determine the weighted average, the total score was obtained by adding the products of each score, multiplied by the number of references to it, and divided by the total number of respondents in each group.

The findings of this study showed that economic factors were of primary importance to the male drop-outs in their decision to leave the profession. The reason "inadequacy of salary" was mentioned most frequently and weighted most heavily by these male respondents. Women listed "marriage" and "pregnancy" as their most important personal reasons for separation from the profession.

The general conclusions in this study showed that:

- Most men left the profession because of economic or financial reasons. Women teachers left for reasons of marriage or child bearing.
- Women respondents indicated a far greater willingness to return to the profession than did the men.
- Women teachers would return to the profession upon discharge of family obligations while some men would return under more favorable financial conditions.
- Some respondents indicated "patterns" of interwoven reasons for separation rather than just one major reason for separation.
- The great majority of respondents separated at the age of 34 or less and had from six to ten years of teaching experience.
- Many respondents indicated combinations of reasons which may be indicative of dissatisfactions within the teaching profession in general.
- Seventy per cent of the teachers in this study who separated, were certified secondary teachers, representing a serious loss in this area of public school education.
- There is an indication of the need for modification or revision of existing salary schedules. Larger and more frequent increments appear to be necessary.

Microfilm \$2.90; Xerox \$10.15. 224 pages.

AN ANALYSIS OF THE ADJUSTMENT AND SCHOLASTIC ACHIEVEMENT OF FORTY PUERTO RICAN BOYS WHO ATTENDED TRANSITION CLASSES IN NEW YORK CITY

(Order No. Mic 61-2581)

Robert Manks Willis, Ed.D.
New York University, 1961

Chairman: Professor Jesse J. Dossick

The purpose of this study was to identify the influence of the transition class on the adjustment, scholastic achievement and retention of forty Puerto Rican boys in a selected New York City academic high school, and to determine the implications such influence has for curriculum improvement.

The problem was handled under the following sub-problems: selection of the academic high school and the boys to be included in the study; collection of data and development of an intensive case study of each boy selected to determine his individual characteristics and needs; classification and study of the social and educational data collected in order to determine the characteristics and needs common to all of the boys in the study; determination of the implications that the social and educational problems of the boys have for curriculum improvement; and specific recommendations for curriculum improvement.

Forty boys were selected for study from the tenth grade at Morris High School. All of the boys selected were born in Puerto Rico and had attended transition classes in New York City. Morris High school was selected at random, from among the high schools in New York City. Only high schools in which the number of Puerto Rican students was more than twenty percent of the total school population were included in the selection.

Data on these students were obtained through the study of class record forms and cumulative record cards; and through interviews with the students, with parents, with teachers, with guidance counselors and with other school personnel. Students who were no longer attending school at the time of the study were designated as "drop-outs" and classified in Group I. Students still attending school at the time of the study were classified as Group II. According to the findings of this study, there are no significant differences between the social and educational characteristics of Group I and the social and educational characteristics of Group II.

Social and educational problems of individual students were identified and recommendations for curriculum improvement were made in terms of each student, in terms of the group, in terms of the school, and in terms of the community.

The recommendations for dealing with the problems of Puerto Rican students included (1) the introduction of transition classes based on a broader concept of social adjustment, (2) English instruction based on the principles of modern linguistic science, (3) a more intensive and more effective guidance program (4) the introduction and use of more effective instruments for the evaluation of the aptitudes and intelligence of the students, (5) more effective and more realistic placement of Puerto Rican students, (6) a more effective program in remedial reading for non-native speakers of English, and (7) a better understanding of Puerto Rican students and on the part of the teachers and other school personnel, and a continuing effort toward education and adjustment on the part of the Puerto Rican students and adults.

Microfilm \$3.45; Xerox \$12.15. 267 pages.

EDUCATION, ADULT

AN ANALYSIS OF THE BEHAVIOR OF COUNTY EXTENSION DIRECTORS AS COORDINATORS OF MICHIGAN STATE UNIVERSITY COMMUNITY DEVELOPMENT PROGRAMS

(Order No. 61-3101)

Jack Calvin Ferver, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Burton W. Kreitlow

Purpose

A great deal of thought is currently being given to the matter of unification of General and Cooperative Extension Services. As this matter is discussed many complex questions are raised. This study deals with one of these questions: can and should the present County Extension Directors of the Cooperative Extension Service serve as

coordinators of the total off-campus educational resources of the university?

The proposition is developed that those County Directors who are currently spending a large amount of time on community development programs exhibit some of the characteristics required of the coordinators of the total off-campus programs.

The problem then comes to be one of identifying the personal and situational factors associated with activity in community development.

Procedure

A panel of thirteen district and state staff members of the Michigan Cooperative Extension and Continuing Education Services assessed the seventy-nine Michigan County Extension Directors on the basis of time spent on community development programs. The twenty County Directors who were thus judged to be in the high quarter on the basis of time spent were then compared with the twenty County Directors judged to be in the low quarter, considering such variables as age, tenure, and county characteristics.

Also, from each of the high and low community development quarters, four County Directors were selected for intensive case study. Three days were spent in each of the eight case counties interviewing occupants of eighteen key positions, including County Extension staff members, members of the county board of supervisors, heads of farm organizations and commodity groups, and occupants of such non-agricultural positions as city managers, planners, and school superintendents. In addition, thirty-one key district and state Cooperative Extension and Continuing Education staff members were interviewed.

The central question asked of all respondents was: how much time are the County Directors now spending, and how much time should they be spending on each of the five agricultural and five community development items?

Conclusions

Those County Directors assessed as being in the high community development quarter were also generally assessed as being in the low quarter in time spent on agricultural programs. Those individuals in either the high community development or low agriculture quarter had substantially higher performance ratings and salaries than those in either the low community development or high agriculture quarter.

County Director behavior in community development does not seem to be related to such factors as age; tenure; nature of undergraduate training; amount of graduate training; or any of eighteen personality traits or characteristics such as self-confidence, introversion, level of aspiration, values orientation, or authoritarianism.

County Director behavior in community development does seem to be related to perceived expectations of significant others; ego strength in certain conflicting situations; the political and economic importance of agriculture in the county; attitude toward nonagricultural program obligations; and desire to do community development.

The tentative conclusion is reached in this study that those County Directors who are well rated by the administration on the basis of their agricultural program activity could be successful in a broadened community development role if they were given the training, given time to make the role transition, and if they had the desire to do so.

Microfilm \$5.25; Xerox \$18.70. 411 pages.

EDUCATION, HISTORY

A HISTORY OF SUPERVISION IN THE
PUBLIC SCHOOLS, 1870-1950.

(Order No. Mic 61-1902)

Henry Warren Button, Ph.D.
Washington University, 1961

Chairman: R. E. Callahan

This historical study is an attempt to recount the history of supervision in the public schools, "supervision" being defined as the direction of teaching and making of decisions intended to affect teaching, performed in a professional capacity. Particular attention is given the relationship of theory and practice in supervision, and the causes of change in supervision. Information is from generally circulated primary sources. Excluded are curriculum decisions, supervision outside cities after 1885, teachers' councils, in-service training programs, and special subject supervision.

Theories of supervision are found to fall into five periods. The first, ending about 1880, was characterized by a belief in the importance of the individual, held by superintendents who had power only to advise. From 1880 until 1905, during a period of centralization and growth of city systems, it was held that teaching practices were determined by an idealistic philosophy of education, and that supervision was to secure and verify conformity with ascertained general truth.

In 1894-1895 the Committee of Fifteen, considering modifications of the elementary curriculum, rejected proposals arising from the child study, "scientific education," and other would-be reformers, and recommended a rigid traditional curriculum. In the formulation of curriculum and methods, psychology and child study were to play only minor parts. In result, innovations in education, including supervision, were deferred for a decade.

After 1905 educational administration was strongly influenced by business and industrial management methods. In this period it was generally felt that decisions and planning were to be done by the administration, and that the function of the supervisor was to convey instruction to the teacher, and to observe and measure in order to determine the efficiency of the teacher. In 1914-1919 there was much evidence of teacher discontent arising from supervisory practices, together with economic pressures. After 1920, presumably as a cause of teacher unrest, writers were concerned with teacher morale as an aspect of supervision. After that time there was great interest in the "science of education," and "scientific supervision." This science, based in procedure on earlier research and industrial time-and-motion study, had only limited value, apparently because of faulty conceptualization and categorization, and lack of theoretical base.

"Democratic supervision," generally accepted after 1940, accompanied a change in theory of administration and in social milieu. Intellectually, it probably was most heavily influenced by Dewey, Kilpatrick and Thayer. In general, empirical approaches seem to have been rejected in favor of principles of "democratic supervision." In the case of two prominent writers, Burton and Corey, the evidence is clear. A content analysis of Educational Leadership, 1943-1950 shows that 8 of 576 articles were

concerned with empirical research, although such research was being conducted then.

In transition periods there seems to have been a pattern. There was, first, advocacy for a change by a few individuals. Some time later, when there was pressure for supervisory change, because of organizational problems within the schools or social pressure on schools and administrators, proposals for change in theory of supervision were generally accepted, and held for a time. At least in two periods, 1905-1920, and 1920-1940, there were large differences between advocated supervision and supervision as practiced. In some instances, changes in supervision seemed to tend to support rather than modify existing practice. Microfilm \$4.60; Xerox \$16.20. 359 pages.

B. F. PITTENGER AND EDUCATION

(Order No. Mic 61-1382)

Clatie Eleanor Clark, Ed.D.
The University of Texas, 1961

Supervisor: Dr. George I. Sanchez

The biography of B. F. Pittenger covers a period of seventy-seven years, and is, in fact, a history of education. Pittenger was born in Shelby, a small agricultural community in Michigan. His first years of formal schooling took place in a one-teacher school. After graduating with honors from Shelby High, he taught in nearby country schools for two years before entering Michigan State Normal College in Ypsilanti.

Pittenger came to Texas for his Master's degree, and fell in love concurrently with Katherine Bickler and The University of Texas. After receiving a Ph.D. from the University of Chicago in the outstanding class of 1916, he returned to The University of Texas, where he remained for forty-one years. From 1926-1947, he served as dean of the College of Education.

This study includes numerous biographical sketches and evaluations of Pittenger's teachers, of the leading members who composed the School of Education of The University of Texas when Pittenger joined this group in 1916, and of the outstanding colleagues whom he recruited for his faculty during his service as dean. Since Pittenger was an active leader in major educational developments for nearly half a century, these activities are given detailed treatment.

Pittenger's writings give a vivid insight into the educational thinking of twentieth century America. An Introduction to Public School Finance, a pioneer effort in the field, was acclaimed one of the most outstanding educational books of 1925. An Introduction to Public School Administration has been widely used as a college textbook. Indoctrination for American Democracy is a stirring presentation which reveals much of Pittenger's sense of values in regard to education and the American way of life. This book was not favorably received by the extreme "progressives."

Pittenger's educational leadership emphasized well-rounded sound academic or general education. He did not minimize the professional preparation of teachers, but maintained that this necessary study should be in addition

to, not instead of, general education. All the degrees in Education currently being offered at The University of Texas were developed under his leadership.

Pittenger's biography and the analysis of his writings point out the factors which shaped his contribution and led to his success in his chosen field. Pittenger had the ability to see both sides of an issue. He had genuine appreciation for knowledge, truth, and learning. He respected and liked people. He wanted to promote progress and improvement for humanity. Toward this end he gave abundantly of his time, energy, and ability. Although he strongly denounced some aspects of progressive education, and fervently upheld indoctrination for American democracy, he usually maintained the "middle ground." This stand was taken because he believed the middle ground to be more nearly the truth. Such a stand resulted in his being able to reconcile and lead divergent groups.

Pittenger was respected by many and disliked by some. Both points of view are given consideration in this objective study of a representative American educator of the modern period.

Microfilm \$6.25; Xerox \$22.30. 491 pages.

BACKGROUND AND DEVELOPMENT OF CONTEMPORARY BUSINESS EDUCATION IN THE PUBLIC SCHOOLS OF PENNSYLVANIA

(Order No. 61-3292)

Ida Grace Routh, Ed.D.
University of Pittsburgh, 1961

Supervisor: George Anderson

The problem was to examine the developments in the field of business education in the public schools of Pennsylvania during the period 1900-1960. Changes, both those caused by local school district activity and those made permissive or mandatory by legislative enactments, were examined.

The elements of the problem were: (1) to determine what business education was prior to 1900 in Pennsylvania; (2) to determine the concept of the business education curriculum in Pennsylvania during the periods 1900-1919; 1920-1939; and 1940-1959; (3) to determine the objectives, scope, enrollment, and teacher certification requirements for business education in Pennsylvania during the periods 1900-1919; 1920-1939; and 1940-1959; (4) to contrast the vocational high school and the comprehensive high school business programs, 1900-1960.

The study was delimited to the public junior and senior high schools and vocational schools of Pennsylvania and further delimited to the period 1900-1960.

The historical-documentary method of research as recognized by Good, Barr, and Scates as an accepted method was used.

The historical development of business education in Pennsylvania from 1682-1899 was determined by a study of the Annual Reports of the Superintendent of Public Schools, circulars, monographs, newspapers, textbooks, reference books, histories of Pennsylvania, and related dissertations and studies. The various State reports and School Codes were examined to determine the historical

development of business education in Pennsylvania from 1900-1960. An analysis was also made of Federal and State legislation to determine changes in regulations affecting business education curriculum, vocational education, and certification of business teachers in Pennsylvania. The growth in business education in terms of enrollment and developments in curriculum for junior high, senior high, and vocational high schools were determined through examination of various reports, courses of study, and bulletins of the Department of Public Instruction.

Some of the conclusions drawn from the study are:

1. Business education has been afflicted with an ever continuing need to strive harder to maintain its status as an equal to academic education.

2. Business education provided terminal education for vast numbers of high school pupils.

3. Private schools were influential in the development of the pattern of business education in the public secondary school.

4. The Department of Public Instruction has taken a role of leadership in business education in Pennsylvania through the appointment of a state supervisor of business education, and development of courses of studies, manuals, bulletins, and reports.

5. Business education in Pennsylvania has always maintained its flexibility to meet the challenges of the demands of business and of economic changes.

6. Evening schools were very influential in the rapid growth of business education.

7. The introduction of new machines and new methods of operation in business offices directly influenced business education.

8. The Smith-Hughes and George-Deen Acts have been influential in business education through studies and investigations made by the Federal Board of Vocational Education.

9. The trend toward area vocational high schools, as a means of providing more and better vocational education for many small districts, enlarges the horizons of business education in Pennsylvania.

10. No differences were found in the pattern of certification of business teachers from that of all other secondary school teachers in Pennsylvania.

Microfilm \$3.85; Xerox \$13.50. 297 pages.

EDUCATION, PHYSICAL

THE EFFECT OF OXYGEN INTAKE ON THE PHYSIOLOGICAL COST OF EXERCISES OF TWO DIFFERENT WORK-LOADS

(Order No. Mic 61-310)

Lemel Dov Aldubi, Ph.D.
New York University, 1960

The purpose of this study was to investigate the effect of pure oxygen intake on the physiological cost of standard work-load exercises.

The problem is important at the present time due to the frequent utilization of oxygen intake of various

concentrations in activities involving endurance, economy in energy expenditure and quick recovery from physical activities.

Since the turn of the century, scientists have investigated the effect of breathing oxygen enriched air or pure oxygen upon performance and on the amount of oxygen used for a given work. Theoretically there should be no difference in the oxygen consumption when breathing atmospheric air or pure oxygen, since the concentration of oxygen in the atmospheric air is sufficient to bring about 98% saturation of arterial blood with oxygen. However, the scant data produced so far showed an increase in consumption when breathing oxygen enriched air, as compared to breathing of atmospheric air. These findings were not conclusive because (a) the exercises were not standardized, (b) the time allotted for recovery was inadequate, (c) only the gross amount of oxygen consumption was compared while disregarding the physiological cost of the exercise.

This investigation was designed to minimize these shortcomings in the following manner: 1. Exercises involving two work-loads were employed. Moderate work-load consisted of walking on an inclined tread-mill at a speed of 3.5 miles per hour. Heavy work-load consisted of running on an inclined tread-mill at a speed of 6.9 miles per hour. The amount of work performed by the subjects was equalized to within ± 50 foot-pounds of the total work. 2. The length of the recovery period, 90 minutes, was found to be adequate to ensure full recovery. 3. The physiological cost of the exercise was computed in order to determine the actual cost of the work done in terms of oxygen expenditure over and above that used for resting metabolism.

Each work-load exercise was performed under two conditions of breathing. The first condition was atmospheric air intake and the second one was pure oxygen intake. The method used for measuring oxygen consumption was the Open Circuit method for atmospheric air intake and the Closed Circuit method for the pure oxygen intake. The comparability of the two methods was secured by equating them through measurements of resting metabolic rate.

Six subjects between the ages of twenty-two and twenty-seven participated in the experiment. The two by two factorial design of analysis of variance was applied. The null hypothesis was rejected at the 5% level of confidence.

The following are the major conclusions drawn from the data:

1. Intake of pure oxygen does not increase the physiological cost of exercise of heavy work-load.
2. Intake of pure oxygen decreases the physiological cost of exercise of moderate work-load.
3. Intake of pure oxygen increases the net oxygen consumption of the exercise period during exercise of heavy work-load.
4. Intake of pure oxygen does not increase the net oxygen consumption of the exercise period proper of exercise of moderate work-load.
5. Intake of pure oxygen decreases the net oxygen consumption during the recovery period of exercises of either moderate or heavy work-load.
6. The smaller physiological cost of exercise of moderate work-load when breathing pure oxygen is probably the result of the smaller net oxygen consumption during the recovery period of the exercise.

7. The smaller net oxygen consumption during the recovery period of an exercise of moderate work-load, when breathing pure oxygen, might be the result of better attainment of relaxation on the part of the subject. This increased relaxation is probably due to a psychophysiological factor induced by the intake of pure oxygen.

Microfilm \$2.75; Xerox \$7.20. 155 pages.

EDUCATION, PSYCHOLOGY

AN ANALYSIS OF PEER RATINGS AND SOCIAL EXPERIENCE

(Order No. Mic 61-1467)

Marlyn Paul Barlow, Ed.D.

The University of Nebraska Teachers College, 1961

Adviser: Dr. William E. Hall, Ph.D.

Purpose of Study

The purpose of this study was to determine the effect of participation in the program of the Nebraska Human Resources Research Foundation (NHRRF) upon the development of social skills of University students who exhibited superior potentiality in mental health attainment. The scores received by NHRRF members on the Friendship Rating Scale (FRS) which was administered in Greek-letter residence houses in which they lived were analyzed and compared to FRS scores received by a non-Foundation control group selected from within the same house. A comparison was made of an objective evaluation of the quality of effort expended in NHRRF activities and the FRS scores received by its members.

Method of Procedure

Over 200 University of Nebraska students took part in the activities of the six Project groups within the framework of NHRRF. Each student was assigned to engage in an investment relationship with some other individual in either Child's Project, Orthopedic Project, Teenage Project or Family Project. Special Functions and Communications Projects were organized and staffed by students already working in the four primary Projects to operate as service groups to the entire Foundation. NHRRF members met weekly in Project groups to set objectives, plan activities for their counselees, and to discuss mutual problems in human relations development. Also, members met individually with their counselees to participate in mutually acceptable experiences planned by the pair. Special meetings were held periodically for the purpose of providing members with the opportunity to meet with successful business, professional, and lay leaders to discuss human resource development.

Six sororities and three fraternities were selected from among those houses on the University campus which had participated in the administrations of the FRS. Means and item scores for all members of the selected houses were tabulated. A group of 97 NHRRF members living in

the selected residence houses was selected, together with an equal-sized control group, for data analysis. The analysis of covariance technique was applied to experimental-control FRS scores (a) one year after the initial matching, (b) two years after matching, and (c) for upper and lower strata of the total FRS range.

Results

1. After one year of participation in NHRRF, female members experienced significant gain in (a) the Total FRS score, (b) Item #1 (Ideal person), (c) Item #2 (Shares secrets), (d) Item #4 (Personal friend).

2. After two years of participation, the female control gained significantly on Item #5 (House president).

3. After one year of participation in NHRRF, the male experimental group gained significantly in Item #1 scores.

4. After one year of NHRRF participation, the experimental "high" group experienced significant gain over the control "high" group on all items of the FRS as well as the Total scores and Peer Class ratings.

5. After one year of NHRRF participation, the "low" experimental group gain was not significant on all FRS items.

Conclusions

There appears to be a positive relationship between the existing level of social skills and mental health status and the growth possible through experience in NHRRF. Members who possess less than average social skills do not seem to gain as a result of NHRRF experience. Activities in NHRRF appear to require a highly individualized approach for the attainment of maximum success.

The FRS does not appear to possess the potential to isolate minor changes in behavior and cannot yield pertinent information of intent underlying behavior. The Scale appears to provide some favorable possibilities for use in selection of prospective NHRRF members when employed with other selective methods.

IBM machine tabulation is highly recommended for speed and accuracy of analysis of future data secured with the FRS. Microfilm \$2.75; Xerox \$6.20. 127 pages.

THE RELATIONSHIP OF SCORES ON THE DIFFERENTIAL APTITUDE TESTS TO SCHOLARSHIP IN HIGH SCHOOL AND COLLEGE

(Order No. 61-3329)

Hattie Hoff Ewald, Ed.D.
State University of South Dakota, 1961

Supervisor: Professor Joseph T. Fisher

The Purpose and Procedure of the Study

The major purpose of this investigation was to ascertain the relationship between scores on the Differential Aptitude Tests and academic success at the high school and freshman college level, and to compare these findings with the relationship found between the subscores of the

American Council on Education Psychological Examination and the same criteria. This also involved the determination of the differential predictive value of the various tests of the DAT and ACE in selected subject areas and in over-all high school and college averages. The biserial relationship between the scores of the DAT and the attrition-survival in high school was also computed.

The population used in this study included those students who enrolled at Central High School, Sioux City, Iowa, in the fall of 1954. The high school graduate group consisted of 158 students and the high school dropout group consisted of 48 students. The freshman college group consisted of 55 students.

The statistical treatment involved nineteen variables. The prediction variables were the test scores of the DAT and ACE and the criterion variables were grade point averages in selected subject areas and in over-all scholarship. The selected subject areas were English, mathematics, science, social studies, business education, and vocational education, whereas, over-all scholarship included averages for the tenth grade, four years of high school, and the first year of college.

The Results of the Study

1. The part scores of the Differential Aptitude Tests obtained in the sophomore year of high school were good predictors of general scholastic success and success in specific course areas. The coefficients of correlation for the total high school graduate group ranged from .023 to .722 with a median r of .411.

2. In general, the part scores of the DAT were better predictors of scholastic success in high school than the subscores of the ACE.

3. Verbal tests generally were the best predictors of over-all academic success and success in specific subject areas at the high school level. The Sentence Test of the DAT was consistently superior to the other variables in the differential prediction of all subject matter scholarship. This test requires only 25 minutes of testing time, which indicates a high degree of efficiency. Numerical Ability of the DAT was also a predictor of significance in several areas.

4. Certain tests of the DAT are not highly effective predictors in the specific areas where their efficiency might be assumed, i.e., Clerical Speed and Accuracy as a predictor of grades in business education and Mechanical Reasoning as a predictor of grades in vocational education.

5. Scores on the DAT obtained at the sophomore level of high school were generally significant predictors of the tendency to remain in high school until graduation.

6. Certain of the tests of the DAT, particularly the verbal and numerical tests, are better predictors of college success than the other tests of the battery.

7. The L-Score and Total Score of the ACE are slightly better predictors of general college success than any single test of the DAT.

8. A combination of the Numerical Ability and Spelling tests of the DAT, yielding a Multiple R of .586, is a slightly better predictor of freshman college success than any single part score of the DAT or ACE.

Microfilm \$2.75; Xerox \$8.60. 189 pages.

THE COMPARATIVE EFFECTIVENESS OF
INDIVIDUAL READING THERAPY
AND GROUP READING THERAPY:
AN EVALUATION OF INDIVIDUAL READING
THERAPY AND GROUP READING THERAPY
ON READING IMPROVEMENT AND ON
CERTAIN ATTITUDES AND PERSONALITY
CHARACTERISTICS OF ADOLESCENT
BOYS RETARDED IN READING.

(Order No. Mic 61-2550)

John Vincent Galotto, Ph.D.
New York University, 1961

Chairman: Professor Nila B. Smith

Problem

The intimate relationship between reading disabilities and emotional difficulties has long been recognized. The purpose of this study was to compare the effectiveness of individual reading therapy and of group reading therapy on reading improvement, attitudes toward reading, self-evaluated personal needs and problems, and classroom behavior. It was hypothesized that the results obtained by individual reading therapy would not be superior to those obtained by group reading therapy.

Subjects

Twenty males, students of a public school, comprised the population of this study. All were retarded in reading and were manifesting difficulties in school adjustment. The boys ranged in age from twelve years and three months to fifteen years and nine months. The range in I.Q. was from 85 to 115.

Method and Procedure

The twenty boys selected for the study were paired according to age, I.Q., reading grade level, and teacher's rating of classroom behavior. Ten of the subjects received individual reading therapy, and ten were placed in two groups of five members each and received group reading therapy. At the completion of twenty reading therapy sessions, all subjects were evaluated according to their rate of improvement in reading ability, attitudes toward reading, self-evaluated personal needs and problems, and classroom behavior.

Results

The results are discussed in terms of the comparative effectiveness of individual reading therapy and group reading therapy on reading achievement, attitudes toward reading, self-evaluated personal needs and problems, and classroom behavior.

1. Individual reading therapy is not superior to group reading therapy in reading achievement.

a. Individual and group reading therapy lead to significant improvement in reading.

2. Individual reading therapy is not superior to group reading therapy in improving attitudes toward reading.

a. Those in group reading therapy show greater improvement (statistically significant) at the termination of treatment than those in individual reading therapy.

3. Individual reading therapy is not superior to group reading therapy in improving personal adjustment.

a. However, it was found that those in individual reading therapy showed a greater over-all improvement in personal adjustment.

4. Individual reading therapy is not superior to group reading therapy in improving classroom behavior.

a. It was found that individual reading therapy significantly improved intellectual traits.

b. Group reading therapy significantly improved social traits.

Conclusions

This study revealed that individual reading therapy is not superior to group reading therapy in improving reading achievement, attitudes toward reading, personal adjustment, and classroom behavior. It also revealed that a psychoeducational approach may be helpful in improving reading ability and, to some extent, attitudes toward reading, personal adjustment, and classroom behavior.

Microfilm \$2.75; Xerox \$5.20. 102 pages.

AN EXPERIMENTAL STUDY OF
CRITICAL THINKING IN
STUDENT-CENTERED TEACHING

(Order No. 61-3331)

Daniel Woodrow Graham, Ed.D.
North Texas State College, 1961

The primary purpose of this study was to determine the comparative effectiveness of student-centered and teacher-centered groups in producing significant changes in certain critical thinking abilities among selected freshmen students at North Texas State College. A secondary aim was to re-evaluate the attitudes of students in the two situations. An experiment was designed with matched subjects to investigate the outcome of critical thinking when influenced by the teaching method variable. The experiment was conducted during the first semester of the 1960-61 academic year in the School of Education at North Texas State College, Denton, Texas.

Eighty subjects were matched in terms of intelligence, age, and first semester in college. The experimental and control classes were taught by the same instructor. The method used in the experimental classes followed previously established criteria for student-centered teaching. The control classes were taught by a teacher-centered process.

Students of the experimental group were matched with subjects of the control group. The Otis Quick-scoring Mental Ability Test was administered at the beginning of the term to secure matching scores. The Watson-Glaser Critical Thinking Appraisal was administered to all students

in the classes at the beginning of the term and again at the end of the semester. An attitude questionnaire and the Schuman Student-centeredness Scale were administered at the end of the semester

The experimental group did significantly better in critical thinking than did subjects of the control group. Results in various phases of the experiment are summarized below:

1. Subgroup comparisons in elementary and secondary education majors and in levels of intelligence gave a gain to students in the student-centered group. The lower intelligence level was the only subgroup producing a difference great enough to be considered significant. This difference was greater than the 10 per cent level of significance.

2. The student-centered group provided a significant gain above the teacher-centered subjects in critical thinking. The significance was greater than the .01 level.

3. A slight gain was made by the student-centered subjects in each of the subtests of the Watson-Glaser test of critical thinking when compared to the teacher-centered group.

4. Subjects in the student-centered group had a more favorable attitude toward the instructor.

5. Student-centered subjects preferred that method when compared to teacher-centered classes.

6. There appeared to be no difference in attitude toward other students in the two groups.

7. Students in student-centered classes believe the teacher has a more favorable attitude toward them when compared to subjects in the teacher-centered classes.

8. Student-centered subjects feel more capable of making decisions than teacher-centered subjects.

9. The same instructor teaching two groups by different methods was able to maintain a difference in the classes as perceived by the students. The significance of the difference was greater than .1 per cent.

Results of the study indicate that when improvement in thinking abilities is desired, teachers could be more effective toward this objective by providing more student-centered opportunities. Furthermore, when education and training demand a product that is better able to make either positive or negative decisions, the educative process could give further assistance toward this goal by providing more opportunities for decisions, as is the case in student-centered situations. Students should be placed in student-centered situations that are especially suited to the development of thinking.

Microfilm \$2.75; Xerox \$5.20. 103 pages.

THE CONSTRUCTION AND VALIDATION OF AN INSTRUMENT TO MEASURE GROUP LEADERSHIP POTENTIAL IN NONACADEMIC COLLEGE SITUATIONS

(Order No. 61-3325)

Robert W. Hayes, Ed.D.

Boston University School of Education, 1961

Statement of the Problem - - The purpose of this study is to construct and validate an instrument that successfully measures leadership potential and to investigate its uses.

Research Procedure - - The study population consisted of the 1960-61 Boston University, College of Basic Studies (BUCBS) freshman class, the freshmen from that class elected to the student council, a sample of undergraduate students from the other schools of Boston University, and the undergraduate members of the Boston University Student Faculty Assembly (BUSFA). Using these population samples, item analyses, reliability studies and validity studies were conducted on the fourth edition of the Leadership Potential Inventory (LP Inventory).

This study consisted of chi-square item analysis, point-biserial correlational analysis, split half and test-retest reliability studies, and four analytical validity studies utilizing the fourth edition of the LP Inventory. The BUCBS freshmen were used in the chi-square analysis, the point-biserial correlational analysis, and the reliability studies. The validity studies are described below:

(A) Through analysis of variance technique, the differences on LP Inventory scores between the four population samples described above were investigated to test the hypothesis that student leaders would score significantly differently than would the general student populations.

(B) From the BUCBS freshman class two samples were chosen, one representing students scoring 1 1/2 S.D. above the mean on the LP Inventory total score and one representing students scoring at 1 1/2 S.D. below the mean. These two groups were formed into small instructional groups containing approximately one half high and one half low students, and they were given seven hours of training in leadership skills. Through the use of analysis of variance, the leadership ability growth rates as measured by leadership behavior ratings and the differences in growth rates were investigated. Through the use of graphic analysis the leadership behavior of the two groups was studied before and after training.

(C) A sociometric evaluation of student perceived leadership was conducted with a sample of the BUCBS freshman class. Through correlational analysis the relationship between student perceptions of leadership potential and LP Inventory total and sub scores was studied.

(D) Through correlation analysis relationships were investigated between the LP Inventory total and sub scores and the sub scores of the Cattell Sixteen Personal Factors Inventory and the Edwards Personal Preference Schedule.

Results - - Through chi-square analysis between the top 27% and the bottom 27% of the BUCBS freshman class, and between the top 27% of the above population and the members of the BUCBS freshman class elected to the student council, eight items were found to be questionable at the .05 level. Through the point-biserial correlational analysis of each item with the total score six items did not reach the .05 level of confidence. There was an overlap in the item selection processes of three items. Therefore, eleven of the forty-five items were found to be questionable.

Test-retest reliability after sixteen days on a random sample of BUCBS freshmen indicated sub test reliabilities ranging from .68 to .72, and a total score reliability of .78. Split half reliability corrected by the Spearman Brown formula for the total score was .80.

The results of validity study (A) showed that there were significant differences on LP Inventory scores between BUCBS freshmen and the student council members, and between the BUSFA and the BU undergraduates. The elected

student leaders had in both cases higher LP Inventory scores and smaller S.D. than did the general population groups. There was also a significant difference between the SFA group and the student council. The SFA had higher scores and was more homogeneous.

Validity study (B) indicated that both high and low scoring groups showed growth in leadership skills at approximately the same rate. Through the graphic analysis a positive relationship between LP Inventory scores and leadership behavior as measured by expert raters was evident. In fact, for the sample studied the LP Inventory total score predicted post training behavior (for the high scoring group) better than did the pre training behavior rating.

Validity study (C), dealing with peer evaluation showed that there was no relationship between LP Inventory total or sub scores and peer evaluations of leadership potential in three different task situations.

Validity study (D) indicated significant relationships between LP Inventory total and sub scores and the Cattell and Edwards inventories in emotional stability, dominance, enthusiasm, conscientiousness, thick-skinned, trust, practical and conforming, confidence and security, and composure. The high LP Inventory scorer also has a high level of group dependence and a low level of succorance.

Conclusions - - The LP Inventory (an attitude/personality inventory) does differentiate between elected student leaders and general population samples in college non academic group situations. There is also a positive relationship between LP Inventory total scores and leadership behavior as assessed by expert raters before and after training in leadership techniques. LP Inventory total and sub scores correlate significantly with the Cattell and Edwards personality inventories in areas that have been reflected by other research. There is no relationship between peer perception of leadership as reflected in a five-man-to-man sociometric rating for three-task situations.

Microfilm \$2.75; Xerox \$7.00. 148 pages.

THE EFFECT OF A PHARMACOLOGICAL AGENT ON AUTONOMIC RESPONSES IN SEXUAL DEVIANTS

(Order No. Mic 61-2561)

Earl Henry Nash, Jr., Ph.D.
New York University, 1961

Chairman: Professor Roscoe C. Brown

The Problem

The purpose of this investigation was to study autonomic physiological responses, as indices of perceptual sensitization, of sex deviants and of non-deviants. It was also the purpose of this research to determine the effect of chlorpromazine on these responses which were elicited by brief exposure to a series of visual stimuli.

It was hypothesized that deviants would demonstrate greater responses to sexually toned stimuli than to neutral stimuli and greater response to the former than non-deviants. It was further hypothesized that chlorpromazine

would more effectively diminish the response in the deviants.

Although there is agreement that adequate methods of treating incarcerated sociopaths are needed, there is uncertainty as to the method of choice. Measures of autonomic physiological function as a means of gathering information about these individuals, and using drugs in their treatment, have received relatively little attention.

The Related Literature

Though much has been written concerning the cause, diagnosis, and treatment of sociopathy, there is still confusion in the literature about this condition. Differential diagnosis has been difficult because of the inability to delimit the factors responsible for the development of sociopathic behavior patterns. Organic, constitutional and environmental factors have been investigated, each implicated but no one exclusively. Currently all seem involved to some extent. Many treatments have been tried, some eliminated but none universally accepted.

It has been established that changes in the autonomic nervous system accompany variations in the emotional state and are not under willful control. However, the exact nature of the relationship has not been established. Little is known about the functioning of the autonomic system in sociopaths, a group often considered emotionally defective.

The tranquilizing drugs have been found useful in treating many mental disorders. Chlorpromazine is noted as having a quieting but not a sedative effect. Tranquilizers have only rarely and inconclusively been reported in treating sociopathy.

Procedure in Collecting Data

The experimental group consisted of 20 sex deviants confined for sexual offenses. The control group consisted of 22 confined individuals with normal sex histories. All subjects were defective delinquents. The groups were matched for age, intelligence, education and length of commitment.

Skin conductance, heart rate, skin temperature, and galvanic skin response were the measures of autonomic responsivity. Response was elicited to a series of briefly presented incomplete pictures (sexually toned) and numbers (neutral) under controlled conditions.

Following the above procedures half of the subjects in each group were administered chlorpromazine for two weeks. The remaining subjects received placebo during this time. After the course of treatment, all subjects were reexposed to the stimuli and their responses again recorded.

The Results of the Study

The autonomic measures were relatively independent indices which in the absence of meaningful stimuli did not differentiate the groups. In the presence of meaningful stimuli the deviants could be differentiated from the non-deviants by their responses. The direction of the difference indicated greater response in the deviants.

After drug therapy, the drug treated deviants demonstrated diminished responses in contrast to the placebo treated deviants who seemed to show even greater response

to the stimuli. Neither of the non-deviant groups (drug or placebo treated) demonstrated such changes.

The Conclusions

Sexual deviants who commit sexual offenses are perceptually sensitized to stimuli with sexual overtones. This sensitization is reflected in the change in activity in their autonomic nervous system when they are exposed to such stimuli. The changes are greater than those occurring in non-deviants.

In the absence of these stimuli (or in the presence of neutral ones) the autonomic activity of deviants is not different from that of non-deviants.

Chlorpromazine diminishes the autonomic response of the deviants to meaningful stimuli.

Microfilm \$2.75; Xerox \$8.40. 181 pages.

AN INVESTIGATION OF THE EFFICIENCY OF THE INDIANA UNIVERSITY FRESHMAN ORIENTATION TEST BATTERY AND ITS IMPLICATIONS FOR COUNSELING AND GUIDANCE

(Order No. 61-3219)

Chawal Paeratakul, Ed.D.
Indiana University, 1961

Chairman: Dr. Howard T. Batchelder

The Problem. The major objectives of the study were (1) to find the maximum predictive validity of the test-battery for various grade-point averages made by freshmen at Indiana University during the academic year 1959-60; (2) to determine the probability that a student will become a member of the attrition group or the survivor group; (3) to find the best estimate of the grade-point averages attained by the survivors; (4) to determine the predictive validity of the test scores for individual marks in 23 selected courses offered in various departments of Indiana University; and (5) to determine the discriminating power of the tests in differentiating between students likely to enroll and those likely not to enroll in the selected courses.

Sources of Data: The five test scores in the orientation testing program on file in the Bureau of Research and Measurement and the grade-point data from the Registrar's office provided the basic data of the study.

Findings and Conclusions: (1) the unbiased predictive coefficient of validity (corrected for selection) of the test battery was $R = .5759$ ($N=2,792$). The STEP test provided the highest contribution toward prediction in most cases. (2) The present battery did not prove to be sensitive enough to be used as an efficient predictor of survival or attrition groups. (3) It is recommended that the 185 expectancy tables developed be used as forecasting devices by academic counselors. (4) The effectiveness of the test battery in predicting probability for enrollment and success in the 23 courses, by discriminant analysis and corrected

multiple correlation, were also presented (5) The need for a more effective counseling and guidance program through the application of the findings from this study was indicated. Microfilm \$5.05; Xerox \$17.80. 394 pages.

THE EFFECT OF PUNITIVE MEASURES ON ATTITUDES OF PRISON INMATES TOWARD AUTHORITY

(Order No. Mic 61-2566)

Ira Rosenblatt, Ph.D.
New York University, 1961

Chairman: Professor Fred N. Kerlinger

This study examines the effects of three levels of within-prison punishment severity upon the attitudes and behavior toward authority of prisoners.

Three values for the independent variable (severity of punishment) were selected:

- a) Mild punishment: Reprimand or Suspended sentence
- b) Moderate punishment: ten days restricted diet
- c) Severe punishment: ten days restricted diet plus ten days loss of good time.

These sentences for infraction of prison rules were imposed by the authorities in the routine manner used at the prison studied (Rikers Island Penitentiary, New York City).

The dependent variable change in professed authority attitudes was evaluated by a Q-sort especially devised and validated for this study. Change in attitude was evaluated by comparison of the prisoners' before-punishment and after-punishment Q-sorts.

An independent estimate of change in behavior toward authority was provided by a Behavior Rating Scale, filled out by the inmates' work supervisors both before and after punishment.

Each punishment severity group contained the subjects of a total of thirty. These subjects were matched for age, I.Q. and length of imprisonment. After collecting the data, it was found that the three groups also showed no significant variation before punishment in their scores on either attitude toward authority (Q-sort) or behavior toward authority (Behavior Rating Scale).

It was hypothesized that punishment would produce increased negative authority attitudes and that the increase would be proportional to the severity of the punishment.

The hypothesis was partially confirmed. While the Severe punishment group, as anticipated, did show a significant increase in negative attitudes and behavior toward authority, the Mild and Moderate groups manifested no significant change on either variable (Q-sort or Behavior Rating Scale).

The data were reviewed in order to evaluate the adequacy of sampling and the suitability of sensitivity of the measuring instruments (Q-sort and Behavior Rating Scale). The evidence seemed to lead to the view that these aspects of the study were suitably handled.

There seem to be two alternative interpretations of the findings. Under the conditions of this study:

- a) the hypothesis is incorrect: Mild and Moderate punishments do not affect authority attitudes or behavior.
- b) the punishments considered Mild and Moderate in this study may not be experienced as punishment by the prisoners, in which case, the hypothesis may not have been properly tested.

(Further study is suggested to clarify this issue as a prelude to final interpretation of the findings.)

Implications of the findings for rehabilitation theory and prison discipline are explored. There is no evidence, for example, to support the common belief that prisoners are re-educated, or that their social attitudes are caused to shift in a constructive direction through the use of punishment. Our findings suggest that punishment does not improve attitudes toward authority. At best, it may not affect them. At worst, punishment appears to increase anti-social feeling.

In performing this study, the potential usefulness of prisons became clearer for the exploration of basic psychological issues in motivation, learning, attitude formation and social organization.

The specific findings of this study seem most relevant to the area of prison and rehabilitation philosophy. They appear to be consistent with those theories which view rehabilitation of criminals as requiring some thing more than inhibition of anti-social behavior through punishment. The typical criminal is seen as one whose development has been defective in the area of learning about the rewards as well as the inevitable frustration of discipline; and that discipline and punishment are not synonymous.

Microfilm \$2.75; Xerox \$8.60. 186 pages.

THE RELATIONSHIP OF ACHIEVEMENT AS MEASURED BY THE NATIONAL MERIT SCHOLARSHIP QUALIFYING TEST TO CURRICULUM AND EDUCATIONAL FACTORS IN SELECTED NEBRASKA HIGH SCHOOLS

(Order No. Mic 61-1474)

Charles Chase Wilson, Ed.D.

The University of Nebraska Teachers College, 1961

Adviser: Dr. J. Galen Saylor

Statement of the Problem

The problem of this study was to analyze the relationship between certain quantitative factors in the high school background of students and achievement in English, social studies, mathematics, and science.

Methods and Procedures

Four Nebraska high schools were included in this study. Each of the schools selected met the criteria of having at least one hundred in the graduating class of 1960. All students included in this study had completed the National Merit Scholarship Qualifying Test in the spring of 1959. Of the four schools selected; one was a four-year parochial school enrolling males only; the remaining three schools were three-year public senior high schools.

Most of the background data used in this study were taken from the individual pupil records which were maintained in each of the respective schools.

Four factors were considered in relationship to achievement. They were: scholastic aptitude; the average of the grades assigned by teachers of the respective areas; the number of semesters of instruction completed in each area; and, sex. Rank in the junior class was also studied.

Achievement was measured by the NMSQT and scholastic aptitude was measured by the scholastic aptitude tests which had been administered by the individual schools. Teachers' marks and the number of semesters of instruction completed in each area were obtained from the permanent records maintained in each school.

Analysis of multiple regression was used to evaluate the relationships of the variables to achievement as measured by the NMSQT. Analysis of covariance was used to test the null hypothesis that there is no difference between males and females in achievement when both groups are held constant with respect to a number of significant variables.

Conclusions

The conclusions reached in this study included the following:

1. Over-all achievement as measured by the NMSQT is highly related to over-all achievement as indicated by the high school rank of each student.
2. Scholastic aptitude is the most significant factor related to achievement.
3. Although not statistically significant at the 5 per cent level, females tended to achieve slightly higher in relationship to their scholastic aptitude than did the males.
4. Without exception, the females were assigned higher grades by the teachers of the various areas than males were.
5. The average of the grades assigned by the teachers of English and social studies are good indications of achievement in those areas.
6. Additional courses in mathematics related significantly higher to achievement in mathematics than any other single variable, including scholastic aptitude.
7. Scholastic aptitude was the only variable which was consistently related to science achievement.
8. There was no significant difference in the English achievement of males and of females when scholastic aptitude and teachers' marks were controlled.
9. Significant differences were found in the social studies achievement of males and of females in two schools. In both cases the males tended to achieve higher than did the females.
10. Significant differences were found between the mathematics achievement of males and that of females. In all cases the males tended to achieve higher than did the females.
11. Only one school indicated that a significant difference existed between the science achievement of males and that of females. In this school the males tended to achieve higher than did the females.
12. The results of this study would support the use of the NMSQT as a measure of achievement in the areas of English, social studies, mathematics, and science.

Microfilm \$2.75; Xerox \$8.60. 187 pages.

EDUCATION, RELIGION

SOME RELATIONSHIPS BETWEEN THE
STATED AIMS OF FOUR
CHURCH-RELATED COLLEGES AND THE
PURPOSES OF THEIR ENTERING STUDENTS

(Order No. 61-3277)

Robert Asher Preston, Ph.D.
University of Pittsburgh, 1961

Supervisor: Lawrence C. Little

1. The Problem

The purpose of this study was to analyze relationships between the stated aims of four church-related colleges and the aims acknowledged by their beginning students at the time of enrollment. The stated aims of the four colleges were examined to determine what they are, their general patterns of emphasis and the distinctive emphases of each college. The purposes of nearly-enrolling students in these colleges were studied to determine their relative importance in the students' decisions to enter college and any patterns of purposes characteristic of each college's entering class. The combined aims of the colleges were examined in relation to the purposes of the entire population of entering students to determine general relationships, and the aims of each college were analyzed in relation to the purposes of its own entering students to determine any specific resemblances between their patterns of emphasis. To the extent that the objectives of the colleges and the students expressed concerns about values, this study deals with a part of the problem of values in higher education.

2. The Method

Within a range of 600 to 1,200 enrollment, four church-related, coeducational, liberal arts colleges in the Western Pennsylvania area were selected for study. They are Allegheny, Bethany, Thiel, and Waynesburg. Their stated aims were analyzed into separate elements and combined into a rating scale which provided for each purpose to be rated by a student as of "most," "moderate," "a little" or "no" importance to him in his decision to go to college or to enter a specific college. The rating scale was administered to all of the new students present at each of the colleges on the first day of freshman orientation. A random sample of 25 freshmen was selected from each entering class and interviewed individually within the ensuing nine weeks. Each interview included an additional administration of the same rating scale, and the free responses of the students were noted during discussion of the meaning of the purposes of most importance to the students, the purposes of least importance, any groupings of apparently related purposes, patterns of emphasis within the entire population, and patterns of emphasis within the population of each college's class.

3. Findings

College aims emphasized religious values somewhat proportionately to the degree of the college's organic relationship to a church. In objectives, the colleges were

similar but distinctive. The students were generally so favorably inclined toward the listed aims that the mean rating of importance of all of the aims was slightly more than "of moderate importance." The interview responses gave a general confirmation of the ratings by the entire population. No groupings of clearly related purposes were discernible. Specific purposes rated as most important were those having to do with verbal skills, clear thinking, personality development, mental health, and various subject matter interests. Of least importance were purposes concerned with general knowledge and historical backgrounds, aesthetic appreciations, citizenship and social responsibility, and some specific religious goals. In spite of differences between the emphases of the colleges, and in spite of differences in the geographical and denominational backgrounds of the students, the student populations were almost identical in their patterns of emphasis.

4. Conclusions

The aims of the colleges were inclusive, combining both traditional and contemporary concepts. The students were most concerned about personal and social enhancement while the colleges emphasized intellectual and religious aims. College aims need periodic review and comparison with curricular content. Student purposes need early clarification. On the first day of freshman orientation many students are at a special peak of idealistic enthusiasm. Microfilm \$2.75; Xerox \$7.00. 150 pages.

A PROPOSED PROGRAM OF BUSINESS
EDUCATION FOR THE MINISTERIAL
STUDENTS OF THE LUTHERAN
CHURCH—MISSOURI SYNOD

(Order No. 61-3231)

Edgar John Karl Walz, Ed.D.
Indiana University, 1961

Chairman: Philip Peak

Problem

This study is concerned with the preparation of a program of business education which can be proposed for training ministerial students of the Lutheran Church--Missouri Synod. By a program of business education is meant a course of study which provides those knowledges and skills which ministers need for efficient management of their personal business, for efficient operation of the business office of the congregation, and for efficient administration of the business of the church.

Sources of Data

Three sources of information were used in an attempt to determine content for the course. These included: (1) The literature in the field of business education with special emphasis on the studies which were concerned with business education for ministers, (2) The objectives for ministerial training which have been established by the Lutheran Church--Missouri Synod, and (3) The opinions

of recent seminary graduates who upon graduation accepted positions in parishes in the Lutheran Church--Missouri Synod within the continental United States and of financial administrators of synodical districts, about 162 topics in the areas of Church Business Management, American Business, and Basic Office and Clerical Knowledge and Skills; which might be included in a proposed program of business education for ministerial students.

Findings

It was found that parish ministers expressed a felt need for a program of business education for ministerial students. This need was reflected in the high rate of return on the questionnaire (93 per cent), the indication that they considered their preparation for managing church business "inadequate," and the high rating which they gave to topics suggested for inclusion in a program of business education for ministers.

Objectives for ministerial training as determined and published by the Lutheran Church--Missouri Synod call for competencies in ministerial candidates which are usually best developed through certain business courses.

Characteristics of congregations in which candidates usually begin their ministry indicate that ministers need to be competent in performing the duties of the church business office, including typing, filing, duplicating, preparing communications, and performing other clerical office duties. The minister's involvement in church budgets, finances, and building projects makes it necessary for him to have some understanding of these matters before he enters the ministry.

Ratings which ministers assigned to 162 topics indicated a desire on their part for instruction in Basic Office and Clerical Knowledge and Skills. Units in Organizing the Church for Business, Managing the Church Office, Managing Church Finances, Managing the Minister's Personal Finances, Public Relations Aspects of Church Business Management, and Legal Aspects of Church Business Management also received heavy emphasis.

Conclusions

On the basis of these findings it was concluded that, in addition to typewriting, economics, and church administration courses (which are now in the ministerial curriculum), the church should also provide ministerial students with instruction in American Business (emphasizing personal finance) and in Church Business Management.

In accordance with these conclusions, Part II of the report presents two course syllabuses for the Proposed Program of Business Education for Ministerial Students. One of the syllabuses presents a course in American Business and the other a course in Church Business Administration. Microfilm \$2.95; Xerox \$10.35. 228 pages.

EDUCATION, TEACHER TRAINING

A STUDY OF EVALUATION OF ACADEMIC ACHIEVEMENT OF SECONDARY SCHOOL STUDENTS IN THAILAND WITH RECOMMENDATIONS FOR IMPROVEMENTS

(Order No. 61-3194)

Mallika Bhaopichitr, Ed.D.
Indiana University, 1961

Chairman: Maurice A. McGlasson

Problem: The major purpose of the study was to analyze principles and practices of evaluation of academic achievement of students in both government and private secondary schools in Thailand. The study was focused on: (1) Teachers' understanding of the role of the objectives of education in the evaluation of academic achievement of pupils; (2) the types of tests, the frequency of tests, the time spent in taking tests, the appropriateness of tests used in evaluation, and the use of test results; (3) the attitudes of teachers and principals toward tests of various types and toward the present evaluation program; (4) methods and devices to be used in determining school marks; (5) the adequacy and inadequacy of the curriculum in providing for pupil growth and development; (6) an analysis of the regulations of examination of the Ministry of Education; (7) the possibility of using standardized tests; and (8) the need for in-service education of teachers and other possible means for better evaluation procedures.

Procedure: American and British related literature were extensively reviewed and Thai documents were translated as background for the study and as a basis for recommendations. Two separate questionnaires concerning current procedures and practices in evaluation of academic achievement of secondary school students were constructed. The questionnaires were distributed among 1,000 teachers in 40 selected secondary schools and 80 principals in 80 selected secondary schools in many part of Thailand (government and accredited private schools only). Eighty per cent of the questionnaires for principals were returned to the Division of Secondary Schools in the Ministry of Education. The data were then tabulated in frequency numbers from which percentages were computed. Interpretation and comparison of the data followed the tables. Recommendations were made on the basis of the findings and conclusions.

Findings: An analysis of the data revealed that teachers and principals (1) preferred a combination of essay and objective questions in once-a-month tests; (2) agreed that tests should be carried out in terms of broad fields, that individual differences should be regarded in the construction of tests, and that tests should be prepared and answer papers should be marked by a group of teachers; (3) did not approve the acceleration of pupils; (4) based the promotion of pupils on 50 per cent of the total marks, and on daily work, periodic tests, and final examination; (5) were satisfied to have the Ministry of Education administer the pre-university examination; (6) suggested a revision of the Ministry regulations of examination, (7) approved the idea of the use of standardized tests in the evaluation program; (8) agreed that tests and examinations should aim at the total growth and development of

the pupil; (9) did not agree on the purpose of tests, the use of tests in educational guidance, and the passing of pupils who were scholastically poor.

Conclusions: In general, teachers and principals in the study were in agreement concerning the main principles and practices of the evaluation of academic achievement of secondary school students in Thailand. However, they did not agree on certain phases of testing and principles of promotion. Microfilm \$3.40; Xerox \$11.95. 261 pages.

COMPETENCIES NEEDED BY VOCATIONAL AGRICULTURE TEACHERS FOR EFFECTIVE FARM MECHANICS INSTRUCTION

(Order No. 61-3195)

William Cola Boykin, Sr., Ed.D.
Indiana University, 1961

Chairman: Earl P. Tregilgus

Purpose

It was the purpose of this study to investigate the skills, abilities, and understandings essential to effective instruction in the farm mechanics phase of vocational education in agriculture. An analysis was made of 213 competencies in farm mechanics on the criteria of: (1) degree of importance, and (2) degree of preparation and "critical" competencies were designated. The study sought ultimately to establish an order of priorities in farm mechanics offerings through systematic analysis; to secure a basis for curriculum revision and subject matter selection in the farm mechanics phase of teacher education in agriculture at Alcorn A & M College, Mississippi; and to secure a basis for the inauguration and implementation of an improved program of in-service teacher education in farm mechanics in Mississippi.

Methods and Procedures

A list containing 351 competencies in farm mechanics was compiled from a review of related literature. This list was later reduced to 250 competencies and from it a numerical rating scale was devised to include 250 competencies and seven successive categories. This instrument was tried out on a random sample of the population. The instrument was again revised to include 213 competencies, grouped into 15 subareas, representing the five currently-recognized major areas of farm mechanics. The number of successive intervals was reduced to five in the final instrument.

A 55 per cent random sample of the Negro teachers of vocational agriculture in the state constituted the population for this study. The investigator toured Mississippi and personally conducted the field survey. Based on the ratings assigned the competencies by the teachers, weighted scores, mean ratings, rank orders, and Spearman rank order correlation coefficients between ranks on the two indices were computed.

Findings and Conclusions

1. There was no significant relationship between the mean ratings assigned by the teachers on the two indices in 12 of the 15 subareas. In two of these subareas there was found a non-significant negative correlation between mean ratings assigned on the two indices.

2. In three of the 15 subareas included in this study the correlation between mean ratings and ranks assigned on the two indices was highly significant.

3. Of the 213 competencies constituting this study the teachers designated 23 as critical; they designated an additional 53 as those which they felt a lack of competence to teach effectively. There were four subareas in which no critical competencies were designated.

4. The teachers tended to assign the more complex farm power-driven machinery low ratings on both criteria; they tended to assign low importance ratings and high preparation ratings to competencies dealing with horse-drawn equipment; they tended to assign high importance ratings and low preparation ratings competencies in modern welding processes.

5. A number of deficiencies indicated by the teachers suggested weaknesses in backgrounds in physics and mathematics.

6. Teachers of vocational agriculture are prepared and are willing to express their estimates of the importance of and their preparation in farm mechanics competencies.

Recommendations

Future plans for the revision of farm mechanics offerings at Alcorn A & M College, Mississippi, should give due consideration to including on a priority basis the 23 competencies indicated by this study as critical. Second on the priority list should be those 53 in which the teachers indicated lack of sufficient competence for teaching. Teacher education should be keenly aware of those competencies which are clearly emerging and of those which are clearly obsolete.

Microfilm \$2.75; Xerox \$8.80. 195 pages.

THE RELATIONSHIP BETWEEN BEGINNING BUSINESS TEACHERS' PROBLEMS AND THEIR UNDERGRADUATE PROFESSIONAL LEARNING EXPERIENCES AT EAST CAROLINA COLLEGE

(Order No. 61-3203)

William Hicks Durham, Jr., Ed.D.
Indiana University, 1961

Chairman: Elvin S. Eyster

Problem

The problem is a study of the relationship between problems encountered by a group of beginning business teachers and problem-related learning experiences provided in professional courses required of the teachers

when they had been undergraduates at East Carolina College, Greenville, North Carolina.

Procedure

Basic to solution of the problem were two bodies of data and determination of the relationship between the two. One body was evidences of problems encountered by the teachers; the other, statements concerning learning experiences provided in the professional courses the teachers had taken when students. Survey techniques were employed in collecting both sets of data. The interview technique, employed in day-long visitations with 52 beginning business teachers in high schools in North Carolina and Virginia, was used to obtain the first body of data; the questionnaire, the second. Teachers and their principals were sources for the first body of data; instructors who had taught the professional courses, the second. Detailed case reports of each school visitation were prepared and subsequently analyzed for evidences of problems. Deducing the problems the beginning business teachers had encountered was largely a thought process involving classifications and analyses of problem evidences for each case separately, and in turn, analyzing the evidences for the group as a whole. Closely related problems were grouped into categories to facilitate the collection of data pertaining to professional learning experiences; refined statements of the problem categories were submitted to the instructors for purposes of obtaining these data. Through critical study of the problems and the learning experiences and of factors relating thereto, relationships between the two were determined. On the basis of the findings, conclusions concerning business teacher education at the College were drawn and recommendations for improvements in the program were made.

Findings

Problems classifiable into nineteen categories within the areas of organization and administration, instruction, evaluation of pupil performance, and nonteaching and professional obligations were revealed. Professional learning experiences in relation to each problem category had been provided within the professional program. Bearing in mind that it might not be possible to provide totally effective preparation for coping with all beginning teaching problems and that a beginner's success in teaching is dependent to a great extent upon his own initiative and effort, three descriptive relationships were discernible: (1) For eight categories of problems, the learning experiences may have been cursory acquaintanceship experiences and may have been inadequate or deficient in number and/or emphasis; (2) For another eight, learning experiences may have been partially ineffective with respect to the practical needs of business educators; and (3) For three categories, learning experiences may have been partially adequate and efficient for those who experienced them, but the exposure of business teacher candidates to those experiences may have been inadequate.

Conclusions

On the basis of the findings, the following conclusions--the solution to the research problem--were drawn:

There was a close relationship between the problems encountered by the beginning teachers and the preparatory learning experiences the teachers had been provided when students at East Carolina College. The areas in which problems were discovered were also areas covered in the learning experiences. The problems encountered by the teachers were anticipated in the preparatory learning experiences; therefore, the preparatory experiences were so planned as to acquaint prospective teachers with problems beginners encounter and to equip them with concepts useful in coping with some aspects of beginning teaching problems.

Microfilm \$4.45; Xerox \$15.75. 346 pages.

RELEVANCY OF LEARNING EXPERIENCES IN COURSES OF THE PROFESSIONAL SEQUENCE AT WASHINGTON MISSIONARY COLLEGE TO PROBLEMS OF SEVENTH-DAY ADVENTIST ACADEMY TEACHERS

(Order No. 61-3208)

Geraldine Isabel Grout, Ed.D.
Indiana University, 1961

Chairman: Dr. Elvin S. Eyster

Problem

The problem is a study of the instructional problems of Seventh-day Adventist academy teachers as a basis for determining the relevancy of the learning experiences provided in the courses of the professional sequence at Washington Missionary College, Takoma Park, Maryland.

Procedure

The study was based upon two factors: first, the instructional problems Seventh-day Adventist academy teachers were encountering in their teaching; and, second, the learning experiences provided in the courses of the professional sequence at the College related to the problems of the academy teachers.

The instructional problems of the academy teachers were deduced from evidences of instructional difficulties discovered during professional visitations to the academies of 55 academy teachers. From these visits numerous individual problems were discovered which grouped themselves logically into 20 problem areas. The learning experiences provided in the courses of the professional sequence were discerned from group and individual interviews with the College instructors, from written reports by the College instructors, and from syllabi used for instruction in the courses.

The major concern of the study was the relevancy of the learning experiences to the problems encountered by academy teachers. The relevancy of the learning experiences was determined in terms of the adequacy or the inadequacy of the experiences to the problem areas. In light of the problem that was studied, therefore, adequacy or

inadequacy of the experiences was revealed in the following three respects: (1) the extent of exposure of students to the learning experiences appeared to be sufficient or insufficient; (2) the nature of the learning activities in which the students engaged seemed to be appropriate or inappropriate; and/or (3) the emphases the instructors gave the experiences appeared to be effective or ineffective. The learning experiences were compared in detail with the areas in which the academy teachers encountered problems in order to discover the relevancy.

Summary of Findings

The comparisons of the learning experiences with the problem areas revealed that the experiences seemed to be relevant to the following problem areas: (1) philosophies of life and education; (2) objectives of secondary education; (3) pupil rapport; (4) physical conditions and facilities; (5) lesson planning; (6) instructional materials; (7) motivation; (8) educational psychology; (9) general teaching methods; (10) specific teaching methods; and (11) measurement and evaluation of student achievement. The experiences seemed to be irrelevant to the following problem areas: (1) philosophies of the teachers' disciplines; (2) objectives of the teachers' disciplines; (3) subject matter; (4) pupil experiences; (5) measurement and evaluation results; (6) non-teaching academy activities; (7) guidance and counseling; (8) relationships with administrators; and (9) personal and professional growth.

Conclusion

In light of the findings pertaining to the relevancy of the learning experiences to the areas in which the academy teachers encountered problems, it may be concluded that the experiences appeared to be relevant to the majority of the problem areas. However, since problems in these areas continue to exist tends to indicate that the experiences may be ineffective to help prospective secondary-school teachers acquire the skills, abilities, knowledges, and understandings necessary to cope with problems in teaching. Microfilm \$2.75; Xerox \$8.40. 181 pages.

THE DEVELOPMENT OF ESSENTIAL CRITERIA FOR A SOUND STATE TEACHER CERTIFICATION PROGRAM

(Order No. Mic 61-1273)

Loren Stanley Ratliff, Ed.D.
University of Denver, 1961

The Problem

The primary purpose of this study was to develop criteria essential to a sound state teacher certification program. A secondary purpose was to determine whether or not the criteria were acceptable to a selected group of persons known to be concerned with education in the state of Colorado. To the extent that the criteria were accepted they could serve as a basis for a plan for the improvement of teacher certification practices in Colorado.

Methods and Procedures

A set of criteria was derived through a comprehensive review of the literature. Books, doctoral dissertations, addresses, pamphlets and research reports dating from Dr. Ellwood P. Cubberley's study published in 1906 to Dr. Laurence Haskew's address at the 1960 San Diego, California Conference of the National Commission on Teacher Education and Professional Standards were reviewed. Statements from the literature relating to certification were compiled, interpreted, classified, and summarized. They were then submitted to four persons professionally associated with teacher education and certification for review. Subsequently a set of criteria deemed to be essential for the improvement of teacher certification was developed.

Following the development of the criteria, a pilot study was made in the state of Colorado. The pilot study was carried out as a part of a study conducted by the Bureau of Educational Research at the University of Denver. A total of 401 opinionnaires which embodied the previously determined criteria were sent to representatives of organizations known to be concerned with education and to institutions of higher learning in the State. Results of the opinionnaire were formulated into recommended changes in the certification requirements for teachers in the state of Colorado.

Findings

The criteria favored centralization of control in the state board of education for the issuance, renewal, and revocation of certificates. The discontinuance of the issuance of life certificates, blanket certificates, large numbers of different types of certificates and substandard certificates was recommended.

The bachelor's degree should be the minimum education for initial certification and the master's degree for the continuing certificate.

Flexibility in certification requirements that would allow teacher education institutions to assert leadership in the development of programs was favored along with a requirement that institutions recommend persons for certification.

The final statement focused on the future of teacher certification in the United States. There were strong indications that teacher education institutions and the profession itself will assume an increasing amount of responsibility in the certification of the teachers for tomorrow.

Results of the Pilot Study

A favorable climate for changes in the existing certification requirements in Colorado was indicated by the results of the pilot study. Twenty-eight of the 29 criteria were accepted by a majority of the respondents.

Microfilm \$2.85; Xerox \$9.90. 217 pages.

AN EVALUATION OF PARENTAL
RESPONSES TO SELECTED TYPES OF
PUBLIC RELATIONS TECHNIQUES USED
BY KINDERGARTEN TEACHERS

(Order No. 61-3225)

Helen Secrest Santry, Ed.D.
Indiana University, 1961

Chairman: Dr. Hanne J. Hicks

Problem. The purpose of this study was to determine and to analyze the techniques of school-public relations used by teachers in the Indianapolis Public School kindergarten, and to determine how parents in a random sample of schools, representing the five socio-economic levels in the total school population of that, or any city of similar size, evaluated the techniques used by kindergarten teachers.

Source of data and procedure. The descriptive survey method was used in the collection and analyses of data for the study. A questionnaire to all kindergarten teachers in the locale of the study was constructed, with validity established by using as independent criteria, the opinions of educators who had written and studied extensively in the field of public relations, and the findings of research pertaining to the subject. More than 87 per cent of the population of kindergarten teachers provided adequate responses to the 16 structured techniques of public relations, expressed their interest and their training in public relations, chose from three philosophies the one which best agreed with their own concepts of public relations, and in their free responses, recommended that the report card should be included in the list of techniques.

From the total population of 133 kindergarten teachers in the 89 schools having kindergartens, a random sample was drawn. This sample represented 1,041 families living in the five socio-economic areas which represent the total school population. A questionnaire to these families requested that they rate, on a three point scale, the degree of help they had received from each of the structured list of school-parent relations techniques used by teachers, and to make free responses to include any additional helps they had received. Parents were, lastly, asked to rank three techniques which they considered to be of first, second, and third importance. Over 67 per cent of the parents returned questionnaires. Responses of both teachers and parents in the sampled schools were set up in tables to facilitate the interpretation of data. Weighted scores were assigned to the first, second, and third choices made by parents from the five socio-economic areas represented in the study. Rankings of those choices were made according to their weighted scores.

Findings and conclusions. With the limitations of the study in mind, conclusions which seemed justified were drawn: (1) Teachers in the Indianapolis kindergartens were making wide use of various techniques of public relations in their attempts to keep parents adequately and continuously informed. (2) The fact that only 16 per cent of the teachers agreed with the philosophy of public relations as cooperative endeavor resulted in the use of parent participation and parent talents being using sparingly, if at all. (3) The personality of the teacher is never to be

disregarded in the assessment of a parent-teacher relationship program. This was expressed by both teachers and parents. (4) The orientation as a first step in guidance, should be used more widely in all socio-economic areas. (5) Parents thought of their own children as good interpreters of the school program. (6) Parents from all socio-economic areas expressed desires for both impersonal and personal techniques for an adequate interpretation program. Parent-teacher conferences were rated highest of all personal techniques, and report cards highest of all impersonal. (7) Relationships between kindergarten teachers and parents seemed to be generally positive, based on an attitude of kinship rather than distrust and false feelings of superiority.

Microfilm \$3.60; Xerox \$12.60. 277 pages.

A FIELD FOLLOW-UP STUDY OF
BEGINNING ELEMENTARY TEACHERS

(Order No. 61-3334)

James Oliver Tate, Ed.D.
North Texas State College, 1961

The primary purpose of this study was to determine the relationship between the level of teaching effectiveness of beginning elementary school teachers and three selection traits.

The hypothesis was formulated that the effectiveness of beginning elementary teachers as rated by their immediate superiors and coordinators of student teaching will vary significantly among below-average, average, and above-average levels of groups classified by temperament, intelligence, and grade-point average.

The study involved a field follow-up of a sampling of seventy-five elementary education graduates who earned degrees in the School of Education at North Texas State College, Denton, Texas, during the academic years of 1958-59 and 1959-60.

To test the hypothesis, the levels of teaching effectiveness were evaluated by personal interviews with each elementary teacher's immediate superior and college coordinator of student teaching.

The resulting data were treated statistically by simple analysis of variance with the F ratio. Three separate statistical comparisons of below-average, average, and above-average groups were made.

The statistical manipulation has yielded information on matters concerning selection and counseling of elementary teachers for adjustment to teaching. It may be inferred from the findings that intelligence was predictive of teaching effectiveness as an indicator of the level of general ability. In turn, the temperament factors of emotional stability, sociability, and personal relations indicated the adjustment capacity for utilizing intelligence effectively in the teaching situation. Finally, the grade-point average was an index of the level at which the subject is actually operating. As a group, the factors of intelligence, temperament, and grade-point average were found to compose a constellation highly predictive of beginning teacher effectiveness. It is concluded that the Committee for Admission of Students to the Elementary Teacher Program of North Texas State College has developed the basis for a valid

and reliable guidance program for the selection of elementary teachers.

On the basis of the findings of experimentation, the following suggestions are made:

1. It is suggested that superintendents and employment supervisors utilize the predictive capacities of the temperament, intelligence, and grade-point-average constellation when selecting teachers for employment.
2. It is suggested that school districts with high scholastic standards and the economic ability to pay attractive salaries utilize the predictive capacities of intelligence, temperament, and grade-point average to identify and employ above-average potential teachers.
3. It is suggested that school administrators utilize the data concerning the prerequisites of successful teaching when conducting in-service training and counseling teachers on professional improvement.
4. It is suggested that college administrators utilize the predictive capacities of the prerequisites to successful teaching when admitting teacher-education students to advanced professional courses.
5. It is suggested that student personnel workers and instructors utilize the prerequisites to successful teaching when assisting students in planning professional and social development, and when counseling for adjustment to effective teaching.
6. Finally, it is suggested that further research be undertaken toward identifying the prerequisites to effective teaching utilizing the personality constellation in an endeavor to provide suitable criteria for measurement.

Microfilm \$2.75; Xerox \$5.00. 97 pages.

A COMPARISON OF THE OBJECTIVES
OF TRADITIONAL HIGH SCHOOL PHYSICS
WITH THE OBJECTIVES OF THE
PHYSICAL SCIENCE STUDY COMMITTEE
COURSE, AND AN ANALYSIS OF THE
INSTRUCTIONAL MATERIALS OF THE
PHYSICAL SCIENCE STUDY
COMMITTEE COURSE.

(Order No. Mic 61-2802)

Leslie Walter Trowbridge, Ph.D.
University of Michigan, 1961

Statement of the Problem

The problem for this investigation was: "To compare the objectives of traditional high school physics with the objectives of the Physical Science Study Committee course, and to analyze the instructional materials of the Physical Science Study Committee course to determine their relevance to the stated objectives."

Methods of Investigation

Objectives of the P.S.S.C. course were compiled from the published materials of the course and interviews with several members of the P.S.S.C. and teachers of the course. Objectives of traditional physics were compiled from textbooks, supplementary materials, and articles on physics teaching in the period 1949 - 1959.

A list of seventy-two objectives of high school physics teaching was formed from the above two lists. Seventeen of these were unique P.S.S.C. objectives, seventeen were unique traditional objectives, and thirty-eight were joint objectives.

Using the objectives as a basis, a questionnaire was prepared, designed to assess the extent of teacher agreement with the objectives, and the extent to which teachers are able to achieve the objectives in practice. The questionnaire was sent to random samples of one hundred P.S.S.C. teachers and one hundred traditional teachers in the nineteen North Central Association states.

The instructional materials of the P.S.S.C. course were analyzed at two separate times, two months apart, by use of a rating scale, designed to assess the degree of incorporation of the objectives in the instructional materials.

Findings

1. The P.S.S.C. course and traditional courses were each found to have several unique objectives as well as a large number of joint objectives.

Seventeen unique objectives were found in the materials of the P.S.S.C. course and included, among others, emphases on the laboratory approach, an integrated film program, the contributions of physics as a pure science rather than applied science, the metric system, and study of a relatively few topics at considerable depth.

Seventeen unique objectives were found in traditional course materials, and included, among others, emphases on applications, the elements of scientific methods, consumer knowledge, verification of physics principles, and breadth of coverage over approximately ten major topical areas.

2. P.S.S.C. teachers and traditional teachers tended to adhere strongly, both with respect to agreement and practice, to the objectives which were identified as unique to their respective courses. The precise effect of the P.S.S.C. institutes is unknown, but it is evident that the experience of P.S.S.C. teachers with the materials and philosophy of the P.S.S.C. course has been very effective in developing strong acceptance of its aims.

3. P.S.S.C. teachers and traditional teachers differed significantly in their responses to the seventy-two objectives of high school physics teaching. Approximately 45 per cent of the objectives showed significant differences of response with respect to the extent of agreement by the two groups. Approximately 36 per cent of the objectives showed significant differences of response with respect to the achievement of the objectives in practice.

4. The degree of agreement and practice of the objectives of high school physics teaching by P.S.S.C. teachers and traditional teachers is strongly affected by the factors of school enrollment, years of physics teaching experience, and class size. Twenty-six comparisons of response by teachers in the various categories showed significant differences.

5. The analysis of the P.S.S.C. materials showed a strong adherence by these materials to the unique P.S.S.C. objectives and joint objectives. Unique traditional objectives received little attention in the P.S.S.C. instructional materials. Microfilm \$3.55; Xerox \$12.40. 273 pages.

EDUCATION, THEORY AND PRACTICE

LAY PARTICIPATION IN CLASSROOM
INSTRUCTIONAL PROGRAMS

(Order No. Mic 61-1476)

D. F. Adkisson, Ed.D.
The University of Tennessee, 1960

Major Professor: Earl M. Ramer

I. PURPOSE OF THE STUDY

The central purpose of the study was to discover developing practices and trends in the utilization of lay assistance in curriculum planning, with particular attention to the use of resource visitors, and to devise, implement, and evaluate onetype of participation in classroom instruction.

The issues to be explored were identified as follows: Will teacher use of resource visitors in the classroom result in--

1. Improved understanding of the school program on the part of lay participants?
2. More favorable attitude toward the school program by lay participants?
3. Increased pupil interest in the instructional area?
4. Improved pupil achievement in the instructional area?
5. A fuller consciousness on the part of teachers of the human resources available and the worth of these resources?

II. PROCEDURES

The following procedures were employed in the collection, analysis, and organization of data: (1) approval of the Bristol (Tennessee) Board of Education; (2) selection of the subject area--science; (3) selection of the grade level--the eighth; (4) development of simple instruments to determine attitudes of parents, students, and resource visitors; (5) selection and use of the Advanced Stanford Achievement Test; (6) selection of control and experimental groups; (7) selection and utilization of resource visitors; (8) collection of other data, such as teacher-assigned grades and student and teacher comments; and (9) survey and analysis of literature and practices.

III. FINDINGS

1. Improved understanding of the school program on the part of resource visitors and a more favorable attitude toward it were reported after their participation.
2. An increased interest in science on the part of pupils as a result of the use of resource visitors was reported by nearly two-thirds of the pupils themselves, by more than three-fourths of parents, and by the teachers.
3. Median eighth grade science achievement grade placements were increased by a gain of a little more than nine months in the seven months between testings.
4. Median grade placements of the experimental eighth grade science classes exceeded comparable median achievement grade placements for the science classes of 1955-56 by one year and three months and the 1956-57 science classes by one year.
5. Achievement records, plus the fact that 76 per cent of the pupils reported an improved understanding of science, suggest that pupil achievement in science was increased as a result of the use of resource visitors. Evidence from achievement tests alone, however, is not conclusive.

6. A fuller consciousness on the part of teachers of human resources available and the worth of these resources to the instructional program was developed.

7. Almost all of the students, resource visitors, parents, and teachers reported the use of resource visitors in classroom situations worthwhile and helpful. This conclusion is supported by professional literature which describes successful use of resource visitors in enriching the curricular offerings of schools and school systems.

Microfilm \$2.75; Xerox \$5.60. 115 pages.

THE RELATIVE EFFECTIVENESS OF THREE
LEVELS OF PICTORIAL PRESENTATION OF
BIOLOGICAL SUBJECT MATTER ON THE
ASSOCIATIVE LEARNING OF
NOMENCLATURE BY SIXTH
GRADE STUDENTS

(Order No. 61-3196)

Ted Charles Cobun, Ed.D.
Indiana University, 1961

Chairman: Henry A. Bern

The Problem and Purposes

Related literature revealed the need of further analysis and application of the concrete-abstract continuum as a concept which relates to and affects the organization of instructional materials. The purpose of this study was to compare the relative effectiveness of three levels of pictorial presentation of biological subject matter on the associative learning of nomenclature by sixth grade students.

Experimental Design

The variables involved were levels of pictorial presentation (photograph, detailed perspective drawing, and outline diagram) and organismal portions of biological subject matter (whole mount, longitudinal section, and excised food processing system). The investigation consisted of a series of replicated experiments using three groups of experimental subjects from the sixth grade level of the elementary school.

All experimental groups were initially administered pretests. Then, each of the groups was exposed to filmed versions of pictorial presentation of each organismal portion of subject matter. Each of the groups was exposed to each of the portions of subject matter using a different level of pictorial presentation and was administered a post-test following exposure.

Three weeks later, all groups were administered a retention test.

Statement of Hypotheses

To test the hypothesis that achievement as measured by scores on a nomenclature test will vary differentially as a function of the concrete-abstract continuum, three null hypotheses were formulated:

1. There is no significant mean test score difference between levels of pictorial presentation of biological subject matter.
2. There is no significant mean test score difference

between organismal portions of biological subject matter.

3. There is no significant mean test score difference resulting from the interaction between levels of pictorial presentation and organismal portions of biological subject matter.

Results

1. On both the post-test and the retention tests the data showed no significant difference in the amount of learning of biological nomenclature gained by the sixth grade classes as a result of the levels of pictorial presentation.

2. On both the post-test and the retention test the data showed a significant difference in the amount of learning of biological nomenclature gained as a result of the organismal portions of subject matter.

3. On the post-test, the data showed a significant difference in the amount of biological nomenclature gained as a result of the interaction between the levels of pictorial presentation and the portions of subject matter. Tests of the significance of the difference between the means showed that there was a significant difference in the amount of learning of nomenclature gained from the presentation of (1) the externals by means of the outline diagram, (2) the excised food processing system by means of the outline diagram and, (3) the internals by means of a photograph.

4. On the retention test, data showed no significant difference in the amount of retention of learning of biological nomenclature as a result of the interaction between levels of pictorial presentation and the portions of subject matter. Microfilm \$2.75; Xerox \$6.20. 130 pages.

A DESCRIPTION AND APPRAISAL OF A REFLECTIVE METHOD OF TEACHING UNITED STATES HISTORY

(Order No. 61-3199)

Charles Benjamin Cox, Ed.D.
Indiana University, 1961

Chairman: Dr. Shirley H. Engle

Problem. The study proposed to determine the results of a reflective method of teaching a high school course in United States history in terms of critical thinking and achievement. Specifically, the study was concerned with (1) determining the extent to which a model of reflective thinking was reproduced in operational terms by classes being taught by a reflective method, (2) determining the extent of the learning of critical thinking skills by these classes, and (3) determining the extent of the acquisition of facts by classes taught by this reflective method.

Method. An evaluation model of critical thinking was devised consisting of the following phases:

1. **Orientation.** Students and teacher increase their sensitivity to a problem situation. Summaries, historical ideas, or generalizations are utilized as springboards for subsequent discussion.

2. **Hypothesis.** A primary, declarative, general statement expressing relationship, explanation, description, or policy is devised as a possible solution.

3. **Definition.** Defining is not an isolable phase of the model inasmuch as meaning and definition are the necessary constants of reflective inquiry.

4. **Exploration.** The hypothesis is more carefully explicated in terms of the logically necessary deductions, the logical implications, and the grounding assumptions and premises it entails.

5. **Evidencing.** The process of making reference to empirical evidence for support or refutation of the hypothesis is conjunctive with exploration.

6. **Generalization.** The conclusion of the process is the statement of the explanatory, causal, correlative, or practical generalization. This statement, often in If-then-always form, represents the most tenable solution to the problem based on available evidence.

The following means were utilized in the description, analysis, and validation of the reflective method in this study:

1. Establishing a consequential (not to be taken in its strict, logical meaning) relationship between the method and classroom behavior which is conducive to or illustrative of critical thinking as judged by an analysis of a daily anecdotal calendar of the classes with reference to the model of critical thinking.

2. Validating the consequential relationship between the method and the hypothesized behavior by making an analytical judgment of a daily anecdotal calendar of comparable classes not taught by the principal method.

3. Validating the consequential relationship between the method and the hypothesized behavior by an analytical judgment of class performances tape recorded on two occasions.

4. Establishing a consequential relationship between the method and students' performance on a standardized instrument purporting to measure critical thinking.

5. Validating the hypothesized relationship by measuring the performance of a group not taught reflectively on the instrument purporting to measure critical thinking.

6. Measuring the acquisition of a body of knowledge in U. S. history by the group taught reflectively by means of a standardized achievement instrument.

7. Validating this achievement by measuring the acquisition of factual knowledge in U. S. history by the matched, non-reflectively taught group by means of the same achievement instrument.

Findings. Tape and calendar analyses showed that the improved reflective skills demonstrated by the students were a result of the principal method. These sources yielded no evidence of such results accruing from the other method. But the standardized test failed to show that the critical thinking abilities of either group had improved. The standardized test used to measure factual knowledge showed an equal acquisition of facts resulting from the two methods. The environmental and substantive changes produced by the reflective method were conducive to critical thinking. Classes so taught improved in their ability to deal critically with questions of fact and value.

Microfilm \$3.55; Xerox \$12.40. 275 pages.

AN EXPLORATORY STUDY OF A SELF-INSTRUCTIONAL METHOD FOR TEACHING EQUIPMENT OPERATION

(Order No. 61-3201)

David Harry Curl, Ed.D.
Indiana University, 1961

Chairman: Beryl B. Blain

Problem and Purpose

Programs for increasing the productivity and social welfare of underdeveloped parts of the world have brought large numbers of adult foreign students to this country for accelerated technical training. These trainees often have had serious difficulty in learning the basic skills essential to their further training because they were unable to understand and follow instructions in the English language. This study reported an exploration of the practicability of teaching certain procedural skills to adult foreign students by means of self-instructional programs. The specific purposes of the investigation were (1) to explore the operational feasibility of the self-instructional programs used, (2) to discover whether captioned pictorial materials could provide demonstration stimuli which were as effective as aural-pictorial materials in programming the tasks to be taught, and (3) to determine whether a predictive relationship existed between performance in the self-instructional situation and individual variations in previous experience, English comprehension, and scores on tests of abstract reasoning and spatial relations aptitudes.

Procedure

Four basic tasks were programmed and presented to 32 ICA Communications and Education Media students as part of their regular course of instruction in photography. Each subject practiced on the item of equipment he was learning to operate while observing slides showing each step in each task. Two of the four tasks were presented with supplementary verbal cues recorded on tape and two tasks had the same words appearing as captions beneath the slides. Learners were allowed to control the rate of presentation of the demonstration programs and to repeat each program as many times as necessary to produce one correct, unaided performance as rated by the experimenter.

Results

About two-thirds or more of the subjects were able to perform each task satisfactorily the first time they were tested after the demonstration-practice sessions. A few more subjects succeeded with the caption versions of three out of the four tasks than with the recording versions, but differences were not statistically significant. Individual subjects proved in general to be consistently either efficient or inefficient in their learning behavior. Previous experience with similar equipment appeared to be a fairly valid predictor of learning efficiency, but no other relationships showed differences that were significant either statistically or by inspection of the data.

Conclusions

On the basis of the findings of this study the writer concluded that:

1. Perceptual-motor skills relating to the operation of certain types of photographic equipment can be taught individually to adult foreign students by means of a self-instructional, demonstration-practice-test type of program.
2. Necessary verbal cues can probably be presented as effectively in caption form as with a recorded commentary.
3. A number of questions were raised indicating the need for further attempts to apply existing knowledge toward development of an operationally functional theory of programming for the teaching of perceptual-motor skills.

Microfilm \$2.75; Xerox \$6.60. 138 pages.

A PROPOSED MATHEMATICS PROGRAM FOR THE COMPREHENSIVE SECONDARY SCHOOL IN THAILAND

(Order No. 61-3209)

Panas Hannarkin, Ed.D.
Indiana University, 1961

Chairman: Dr. Maurice A. McGlasson

Purpose of the Study. The purpose of this study is to propose an appropriate mathematics program for the comprehensive secondary school, from grades 8 to 12, in Thailand. The problems include the following: (a) the identification of the functions of the comprehensive secondary school, (b) the identification of the criteria for the selection of content and organization of a mathematics program that will meet the objectives of teaching mathematics in the secondary school and also correspond to the objectives of education as stated in the 1960 Thai National Scheme of Education.

Sources of Data. Data for this study were obtained from current practices, trends, and opinions of experts in the field of mathematics education, as revealed in the professional journals and textbooks, the textbooks and curriculum guides for secondary school mathematics program in various school systems, and the recommendations of the committees on improvement of mathematics education on the secondary school level.

Findings. The following conclusions were arrived at from the data surveyed:

1. The comprehensive secondary school should provide an education which will suit each individual student in terms of his needs, abilities, and plans for the future.
2. A good mathematics program should possess the following characteristics: availability to all students, contemporary in content and capable of meeting the needs of the present, continuity of content offered, the integration within the field, and provision for individual differences of the students.
3. Normally, general mathematics is offered in grades

7 and 8, algebra or general mathematics in grade 9, geometry in grade 10, and second year algebra and trigonometry in grade 11. There are a variety of offerings in grade 12.

4. At the present time it is generally agreed that calculus should not be included in the normal college preparatory mathematics program in high school, that solid geometry and plane geometry should be combined into a one-year course, and that a course in inferential statistics and probability and another course in theory of sets should be introduced into the high school curriculum.

5. In the preparation of mathematics teachers on the secondary school level, at least 21 credits of college mathematics should be required for the fulfillment of the teaching license.

Conclusions and Recommendations. As a result of this study, the following recommendations are made:

1. General mathematics should be offered to the eighth grade students so that they might explore their abilities, needs, and aptitudes.

2. Statistics should be added to the general mathematics courses for the non-academic students in grades 9 and 10.

3. New areas of mathematics that should be introduced to students in the academic track are solid geometry, coordinate geometry, and inferential statistics.

4. To modernize the mathematics program the following topics should be introduced into the curriculum: scientific notation, the binary system, complex numbers, vectors, sets, groups, and fields.

5. To be successful in teaching mathematics in this program, it is felt that the teacher on this level should earn at least a B.A. degree with a major in mathematics.

Microfilm \$3.05; Xerox \$10.80. 236 pages.

THE RELATIVE STABILITY OF YOUTH
PROBLEMS AND PROBLEM BURDENS
AT THE SENIOR-HIGH-SCHOOL LEVEL,
GRADES 10, 11, AND 12.
(VOLUMES I AND II).

(Order No. Mic 60-6656)

Luther Alfred Howard, Ed.D.
Boston University School of Education, 1959

Purpose of the Study

The primary purpose of this study was to determine the relative stability of the different problems and problem burdens of a senior-high-school population, grades 10, 11, and 12, and to show how this stability varies with sex, grade, and intelligence quotients.

Method and Procedure

The Billett-Starr Youth Problems Inventory, Senior Level was administered twice to 825 pupils selected from Marblehead High School, Marblehead, Massachusetts and Dedham High School, Dedham, Massachusetts. The first administration of the Inventory took place during the first week of October, 1956, and included the entire population. The testing was conducted by the homeroom teachers, who

had been thoroughly briefed and supplied with directions by the writer, during the activity or X-period plus the next period in the school schedule.

For the second administration, the population was divided as nearly as possible into thirds, with approximately one third of each grade level included in each of the three time interval groups, 30-days, 60-days, and 90-days. The first group was re-tested during the first week of November; the second group during the first week of December; and the third group during the first week of January.

To insure complete anonymity, each pupil was given a three digit code number. A double sticker-type tab with a perforated line between was pasted on the cover page of the booklet, with the pupil's name typed on the upper half and his code number on the lower half. When taking the Inventory, the pupil simply removed the upper part.

Results

The following results were obtained from this study:

1. The problems of most concern to senior-high-school youth in each time interval group are quite similar, and the relative stability of these same problems does not vary to any great degree in most instances.
2. As a group, Grade 10 mark the most problems per pupil, with Grade 12 ranking second, and Grade 11 third.
3. At the 30-day interval, Grade 10 has the most number of problems showing a relative stability above the fifth decile range, with Grade 12 ranking second, and Grade 11 ranking last.
4. At the 60-day interval, where the highest relative stability is evidenced on the Inventory, Grade 12 has the greatest number of problems above the fifth decile range, while Grade 11 ranks second, and Grade 10 last.
5. At the 90-day interval, both Grades 11 and 12 show a decline in the number of problems having a relative stability in the sixth to tenth decile range when compared with the 60-day population but Grade 10 shows a small increase. Grade 12 again has the most problems in the above category, with Grade 10 a close second, and Grade 11 last.
6. The number of problems marked by the two intelligence quotients groups is nearly equal, but the pupils with the highest intelligence quotients have more items showing a relative stability above the fifth decile range than do the pupils with the lowest intelligence quotients. The greatest difference in number of problems with a high stability between the two groups appears in the areas of School Life and Morality and Religion. Both categories show a greater stability with the high intelligence group.
7. The fewest numbers of problems having a high stability - above the fifth decile range - in each time interval group tend to fall into four areas: Personal Finance, Heredity, Interests and Activities, and Morality and Religion.
8. The area of Planning for the Future has a higher relative stability with Grade 12 pupils than with

either of the other two grades. In the two sections of this area "educational planning" and "occupational planning," the former section is of very little concern to the low intelligence group.

Microfilm \$17.40; Xerox \$62.15. 1381 pages.

UTILIZATION OF FILMSTRIPS AS AN AID IN TEACHING BEGINNING READING

(Order No. 61-3213)

Thomas Daniel Kelley, Ed.D.
Indiana University, 1961

Chairman: Dr. Hanne J. Hicks

Purpose of the Study. The purpose of this study was to determine whether reading instruction could be improved through the use of filmstrips which reproduced the basal text plus lessons in structural and phonetic analysis from the teacher's manual.

Procedure. One division of control classes and two divisions of experimental classes were used in the study. Subjects were 138 children in the second semester of first grade in nine elementary schools in Michigan City, Indiana. In the control classes instruction followed the Scott-Foresman basal textbook and the methods outlined in the accompanying teacher's manual. In the two experimental divisions of classes the filmstrips reproduced the text and pictures of the same Scott-Foresman textbook plus lessons in structural and phonetic analysis from the teacher's manual. The two experimental divisions differed in that in one students were grouped for instructional purposes while in the other the classes were taught as a whole.

Alternate forms of the Gates' Primary Reading Tests were used as pre-tests and post-tests. Analysis of covariance was used as a statistical treatment, adjusting the final test scores for the pre-test scores. Analysis of variance among the means of the intelligence quotients of the three groups did not reveal significant differences among the groups.

Findings. The experimental classes, using the filmstrip method, were significantly superior to the control classes on the word recognition test, the sentence reading test, and the mean of the three tests. On the paragraph reading test there were no significant differences among the experimental and control groups.

Girls' scores, analyzed separately, revealed no significant differences on the word recognition test, sentence reading test, paragraph reading test, and mean of the three tests among the experimental and control groups.

Boys' scores, analyzed separately, indicated that boys in the experimental classes were significantly superior to boys in the control classes on the word recognition test, sentence reading test, the paragraph reading test and the mean of the three tests.

Teachers saw many advantages in the filmstrip method, as revealed by questionnaires sent to teachers of the experimental classes at the conclusion of the experiment. Teachers felt that filmstrips improved interest, stimulated class discussion, helped to fix basic vocabulary, provided

encouragement for the timid child, reduced their lesson preparation time, improved picture perception, helped children in phrasing, helped slower students remember story details, were useful and convenient for review, speeded reading progress, provided convenient, easily accessible charts, helped in phonetic and structural analysis, and were liked by children as "a new way to read."

Conclusions and Recommendations. The superiority of the filmstrip method in the areas of word recognition, i.e., in fixing the basic vocabulary, and in sentence reading suggest that this technique is especially valuable during the early school years when these instructional jobs are so important.

The filmstrip method seems to be particularly advantageous for boys. This discovery fills a definite need in our educational curriculum. Boys have had more difficulty than girls in beginning reading. A method which significantly improves the reading abilities of boys in beginning reading offers significant potentialities.

From the evident superiority of the experimental classes, grouped for instructional purposes, as compared with the experimental classes taught as a whole, the continuing values attributed to grouping children for instructional purposes also appear to be justified.

The investigator believes that the use of the filmstrip correlated with the basic text is not a panacea automatically providing the ideal reading curriculum for each child, but that it does seem to offer significant values in helping to prepare the child for meaningful reading.

Microfilm \$2.75; Xerox \$6.20. 127 pages.

AN EXPERIMENT TO COMPARE TERMINAL ACHIEVEMENT IN SECOND-SEMESTER SHORTHAND CLASSES TAKING DICTATION FROM THE TEACHER AND CLASSES TAKING DICTATION FROM A RANGE OF TAPE-RECORDED MATERIAL

(Order No. 61-3133)

Ellen Louise Lensing, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Russell J. Hosler

The purposes of this study were (1) to compare terminal achievement in second-semester shorthand classes who developed speed in writing readable shorthand by selecting practice material from a range of recorded dictation and classes who practiced from "live" dictation; and (2) to evaluate the attitudes of teachers and students toward electronic dictation practice.

A total of 145 high school students in Madison (Wisconsin) East High School and Racine (Wisconsin) Washington Park High School were taught by four different teachers in seven shorthand classes--four classes using taped practice materials and three using "live" dictation. Three teachers taught both a control ("live" dictation) and an experimental (taped dictation) class; the fourth taught only an experimental class.

Procedure:

Consoles, housing four tape playback decks, thirty individual listening stations with earphones; and a portable listening station for the teacher were installed; and programs of recorded dictation with "preview" sheets for each program were supplied for each school. Fundamentally similar lesson plans were followed in each teacher's control and experimental classes, except that taped material freed the teacher for individual instruction during writing practice in the experimental classes. Each teacher, however, developed her own lesson plans; so one teacher's actual classroom activities were not necessarily similar to another's.

The initial similarity of classes was estimated by age, grade level, IQ scores, over-all grade point average, first-semester shorthand grade and a pretest score based on transcripts prepared from three minutes of "live" dictation. Achievement was measured by tape dictation tests given at six-week intervals throughout the semester. Observation, interview, and questionnaires provided information relating to actual instructional activities in the classroom and to the attitudes of teachers and students toward experimental procedures.

Results:

Analysis of variance showed statistically insignificant, but consistent, initial differences among the groups. The means of the final test scores, therefore, were adjusted by predicting final scores with the multiple regression equation using grade point, shorthand grade, and pretest as predictors. Differences between adjusted means for each teacher's classes ranged from 0 to 1.5 per cent accuracy on tests dictated at the same speed. Analysis of variance of the residuals between actual and predicted scores showed insignificant differences among the groups.

Differences between control and experimental classes in attitude toward electronic dictation were significant at the .001 level. Though both groups tended to have favorable attitudes, experimental groups favored taped dictation more strongly than control groups. A strong interaction term (.001 level) caused differences between groups to disappear when teachers were treated as a random sample.

Conclusions:

1. Teachers and students alike were enthusiastic about the use of taped dictation, though experimental students favored taped dictation more than control students did.
2. Attitudes of students toward certain aspects of the experimental procedures seemed to be related to procedures to which they were accustomed.
3. There were no significant differences between the groups in terminal speed in writing shorthand.

Microfilm \$4.20; Xerox \$14.65. 325 pages.

IMPLICATIONS OF AUTOMATION FOR INDUSTRIAL EDUCATION

(Order No. 61-3223)

Denver Sams, Ed.D.
Indiana University, 1961

Chairman: Dr. Earl P. Tregilgus

Problem

The study was concerned with determining the influence of automation on-the-job requirements of two groups of skilled tradesmen, toolmakers and machinist-repairmen, and with the effectiveness of preparation of graduates of vocational machine shop programs for entry into the apprenticeship of the trades.

Methods

Data regarding the influence of automation on job requirements were collected by interviewing 55 tradesmen in a partially-automated plant manufacturing common automotive parts. The data regarding preparation for entry into the trades were collected by mailing a written questionnaire to 225 vocational machine shop teachers in four states. Both the interview and the questionnaire dealt with 203 items of manipulative skill and related technical information. The importance of each item was rated in terms of the frequency of use in the trade, and in terms of the intensity of training given by the teachers.

The raw data were transformed into special indexes to permit a comparison of the ratings given by the various groups. Correlates regarding the appropriateness of the training in the vocational machine shop programs to the practices of the various skills in the trades were computed by the rank-order method. The special indexes used were a representation of the importance of each item as rated by all the respondents. The indexes were based on the assumption that changes in frequency of use of a skill after the introduction of automation in a plant represented an influence by automation.

The investigator found no acceptable instrument for the assessment of the influence of automation on job requirements in skilled machine trades. The method used was that of opinion rating, with the rating given by the skilled tradesmen and the teachers.

Findings

Examination of the data revealed that:

1. The toolmakers felt that a very slight change in the frequency of use of only 17 of the various skills resulted after the introduction of automated equipment.
2. Machinists-repairmen did not record any changes in the frequency of use of any of the skills because of automation.
3. Both toolmakers and machinist-repairmen rated five of the related technical information items substantially more important after automation. These items related to hydraulics, electricity, electronics, pneumatics, and the machining properties of plastics.
4. There were substantial differences between the ratings given by the tradesmen and the teachers for several of the skill and information items. These appeared

to be largely due to the lack of modern equipment in some of the school shops.

Conclusions

1. There is no indication that automation had any real influence on the skill requirements for these tradesmen.
2. Automation definitely brought increased importance to technical knowledge pertaining to the basic fundamentals of hydraulics, electricity, electronics, pneumatics, and the machining properties of plastics.
3. There was extremely close relationship of the training to about 60 percent of skills as practiced in the two trades.
4. The instruction being given in related technical information to persons enrolled in the machine shop programs is substantially in agreement with the importance rating given by the tradesmen. The notable exceptions included hydraulics, electricity, electronics, and pneumatics. Microfilm \$2.75; Xerox \$6.60. 136 pages.

INTERRELATIONSHIPS OF READING, LISTENING, ARITHMETIC, AND INTELLIGENCE AND THEIR IMPLICATIONS.

(Order No. 61-3289)

Isabella Hastie Toussaint, Ph.D.
University of Pittsburgh, 1961

Supervisor: Donald L. Cleland

The general purpose of the study was to determine which combinations of selected measures of listening comprehension, arithmetic computation, and intelligence would be the most useful in estimating an intermediate grade pupil's capacity for achievement in reading. More specifically, the purpose was to investigate the relationships between the criterion measure of reading and the selected measures of listening, arithmetic, and intelligence; to determine the interrelationships among these same measures; and to seek answers to related questions.

Five group tests and one individual test were administered during the spring of 1960 to 172 pupils in grades four, five, and six of two elementary schools in Western Pennsylvania.

The Pearson product-moment coefficients of correlation were computed from raw scores on all combinations of tests.

The multiple coefficients of correlation were statistically determined by the Doolittle method to ascertain the optimum weights to be assigned to the best combination of independent predictive variables.

The "B" coefficients were calculated to determine the optimum weight to be assigned to independent variables in predicting or explaining variations in reading. Appropriate equations were derived.

Some of the principal findings were:

STEP Listening, 4A showed a closer relationship with reading achievement, as measured by the Gates Reading Survey, than the Durrell-Sullivan Reading Capacity Test.

The Stanford-Binet Intelligence Scale, Form L-M and the SRA Primary Mental Abilities showed approximately

the same relationship with reading achievement as measured by the Gates Reading Survey.

The combined action of STEP Listening and SRA Primary Mental Abilities yielded a higher estimate of reading potential than any other combination of two selected measures.

The combined action of STEP Listening, American School Achievement, Arithmetic Computation, and SRA Primary Mental Abilities yielded a higher estimate of reading potential than any other combination of three selected measures.

The findings indicated that estimating an intermediate grade pupil's reading potential from a combination of selected measures of listening comprehension, arithmetic computation, and intelligence is more accurate than from any one test alone.

The wide range of the reading ability of intermediate grade pupils predetermines a large error of estimate in prediction, and indicates that in estimating reading potential of an intermediate grade pupil thoughtful consideration should be made of individual differences.

Microfilm \$2.75; Xerox \$5.40. 106 pages.

A COMPARATIVE ANALYSIS OF MOTION PICTURE PRODUCTION COURSES OFFERED IN SELECTED COLLEGES AND UNIVERSITIES IN THE UNITED STATES

(Order No. 61-3230)

John Henry Tyo, Ed.D.
Indiana University, 1961

Chairman: L. C. Larson

The Problem

The purpose of this study was to survey motion picture film production instruction at the ten colleges and universities offering the bulk of such courses in this country, with the intention of making recommendations which would help to improve instruction in film production. Information was sought relative to: 1. administrative practices in motion picture film production teaching units, 2. the extent of film production courses in the selected institutions, 3. the methods of instruction which were used in such courses, 4. the content of such courses, and 5. methods of evaluation used by instructors of film production courses.

Procedure and Sources of Data

In an effort to determine the status of film production training in the United States, related literature and research was studied for descriptions, case studies, surveys, problems, findings, recommendations, and conclusions. In particular, the nine research studies dealing with film production courses in the United States were reviewed, which served to locate and identify the ten institutions offering the most film production courses. They were: Indiana University, Boston University, Columbia University, New York University, City College of New York, Bob Jones University, University of Miami, Syracuse University, University of California, at Los Angeles, and University of Southern California.

In 1959, and continuing through the spring of 1960, each of the ten institutions was visited. Ten administrators of film production courses were interviewed, as well as 104 teachers of 172 motion-picture course-units.

An Administrator's Interview Guide was constructed under four headings: 1. organization of film production courses, 2. instructional policies, 3. staff characteristics, and 4. future plans. Instructors' Interview Guides were divided into three sections: 1. method of teaching, 2. course content, and 3. evaluation methods. For the sake of the analysis, "film production" was divided into eleven categories: 1. acting, 2. animation, 3. cinematography, 4. directing, 5. editing, 6. laboratory techniques, 7. lighting, 8. make-up, 9. sound recording, 10. supervision and management, and 11. writing.

Findings

1. For the survey year, there were 442 undergraduate and 243 graduate students majoring in film production in the 10 schools.
2. Administrators ranked writing, directing and editing, in that order, as the most important of the 11 subject areas.
3. There were 108 film production teachers in the 10 schools; 65 were full-time, 30 were part-time, and four were teaching assistants.
4. There were 172 course units in the 11 subject-areas. Writing, cinematography and editing made up 54 per cent of the course units.
5. Including film production workshops, there were 10,529 class hours of instruction offered in the survey year, of which the top three schools offered 55.1 per cent.
6. An analysis of the rating scales administered to 104 film teachers revealed that the lecture method of instruction was the most popular, followed by individual student conferences. Subjective evaluation of the students' progress over the period of the course was reported to be the most effective evaluation technique.

Conclusions

1. Serious attention should be given to clarifying the role of film production instruction at the college level, such that courses assume a professional status, above the "trade school" stratification, while retaining enough practicality to lend substance to theoretical emphases.
2. There is a need for a wider dissemination of information concerning film production courses, not only to local university personnel, but to the educational community at large.

Microfilm \$3.20; Xerox \$11.25. 247 pages.

CRITICAL REQUIREMENTS FOR HIGH SCHOOL TYPEWRITING TEACHERS BASED UPON AN ANALYSIS OF CRITICAL INCIDENTS

(Order No. 61-3001)

James Jolliff Weston, Ed.D.
University of Arizona, 1961

Supervisors: O. K. Garretson
H. J. Langen

Purpose

The purpose of this study was to determine critical requirements for high school teachers of typewriting. There were three specific objectives: (1) to collect and analyze a group of critical incidents performed by typewriting teachers; (2) to develop a technique applicable in this and related business education areas; and (3) to evaluate the effectiveness of the critical-incident technique as a method of research for determining critical requirements for teachers of business education skill subjects.

Research Procedure

The research procedure used in this study was an adaptation of the method of research known as the critical-incident technique. The critical-incident technique is a behavioral approach consisting of a set of procedures for the collecting and analyzing of observed effective and ineffective behaviors relative to the performance of a job or activity.

For this study a critical incident was defined as a written, detailed report of an observed classroom situation, practice, or incident involving a typewriting teacher in which that teacher's behavior was judged particularly good and/or appropriate, or particularly poor and/or inappropriate by an observer. The critical incidents for this study were obtained by means of a questionnaire mailed to four groups of observers, public high school typewriting teachers, administrators, and students, and professional secretaries. The teachers and administrators were selected randomly from throughout the state of Arizona. In turn, each administrator selected was asked to choose two high school students to participate. The secretaries were selected randomly from the memberships of the Arizona chapters of the National Secretaries Association.

Findings, Recommendations, and Conclusions

The mailed-questionnaire method developed in this study was successfully used to obtain written reports of critical incidents performed by typewriting teachers from over a sizeable geographical area. The observers who returned completed questionnaires were able to report usable critical incidents performed by typewriting teachers.

Two hundred and ninety-four usable critical incidents were reported by the observers. Analyses of these data revealed that they fell under three categories: (1) Personal Traits and Habits of Typewriting Teachers, (2) Classroom Management by Typewriting Teachers, and (3) Instructional Procedures Used by Typewriting Teachers. The critical incidents under the three categories were arranged into twenty-one sub-categories. At least one

critical requirement was written describing the critical incidents contained under each sub-category, and a total of twenty-six such critical requirements were written. A critical requirement was defined as a descriptive statement in behavioral terms describing a significant behavioral pattern to which a typewriting teacher, to be effective, should conform.

The final list of critical requirements determined in this study is, in many respects, quite similar to certain other previously published lists of desirable typewriting-teacher qualifications. Despite that similarity, the critical requirements determined in this study take on added significance when it is considered that each was derived from a set of observed classroom behaviors. Because of this added significance it seems that in addition to being used by high school typewriting teachers as a guide for self-evaluation and self-improvement, the critical requirements derived in the present study should be used by high school administrators, supervisors, and department heads, to supplement other devices or means for evaluating the performance of typewriting teachers. Also, it is suggested that these critical requirements be given consideration by college and university officials who are responsible for training business education teachers for the secondary level, and by school administrators or officials responsible for planning in-service education programs for business education teachers.

Because of the similarity existing among the critical requirements determined in the present study and certain other previously published lists of desirable typewriting-teacher qualifications, however, it appears that the present study was laborious and time consuming in relation to the results achieved. Therefore, it would hardly seem justifiable to recommend the undertaking of similar studies for determining critical requirements for teachers of the other single business education skill subjects. Instead, it would seem logical, in the light of the past applications of the technique as well as the results of the present study, to consider future critical-incident-technique studies for determining critical requirements for broader business-education-teacher classifications such as for teachers of skill subjects in general, or for teachers of non-skill subjects. Microfilm \$3.25; Xerox \$11.25. 250 pages.

AN EXPERIMENTAL COMPARISON OF
EQUIVALENT VERBAL AND
VERBAL-PICTORIAL TESTS IN A
UNIVERSITY AUDIO-VISUAL COURSE

(Order No. 61-3232)

Fred Earl Williams, Ed.D.
Indiana University, 1961

Chairman: Professor Carolyn Guss

The purpose of this study was to compare experimentally verbal with verbal-pictorial achievement tests in a

course where content presentation was highly visualized. The basic question to be answered by the study was: What effect does the use of non-verbal material as an integral part of achievement tests have on the effectiveness of the test in measuring student accomplishment? More specifically, when learning from visualized presentations was measured by equivalent verbal and verbal-pictorial tests, which test: 1. gave higher scores? 2. correlated more highly with an independent criterion? 3. gave better discrimination between students? 4. gave higher scores for better students and higher scores for poorer students? and 5. was less difficult?

A university audio-visual course in the preparation of teaching materials was selected as a course using a wide variety of audio-visual materials for class presentation. Following recommended procedures a test on the course content was prepared with each question in two forms; verbal and verbal-pictorial. Particular care was taken to control the content equivalency of two forms of each item. Two versions of the test were assembled, each containing either the verbal or the verbal-pictorial version of each question, but not both. Test items were intermixed as to format so that each student, in effect, took a verbal and verbal-pictorial test and so acted as his own control. The subjects were divided into two groups, those completing the course over a full semester and those completing the course in a two weeks short session. The results were analyzed by non-parametric statistical techniques.

The general conclusion derived from the analysis of the data obtained was that, in measuring learning from presentations using non-verbal materials, equivalent verbal and verbal-pictorial tests yield different results. Specifically: 1. Verbal-pictorial tests gave significantly higher scores. 2. Neither test correlated better with the outside criterion, which was instructor assigned ranks based on quality of products produced. 3. When classified on the basis of combined verbal and verbal-pictorial test scores, better students scored significantly higher on the verbal-pictorial test while poorer students did as well on one form as the other. 4. In terms of difficulty and discriminative ability there was no best form of test item, some favored the verbal version, some the verbal-pictorial, while many did as well in either form.

Microfilm \$2.75; Xerox \$7.60. 161 pages.

ENGINEERING

ENGINEERING, GENERAL

ON THE THEORY OF MINIMUM COST INFORMATION-COLLECTION SYSTEMS

(Order No. 61-3298)

John Carlton Chambers, Ph.D.
Case Institute of Technology, 1961

An information-collection situation, as defined in this research, is a sampling design problem where the sample mean is used for decision making. An information-collection system is specified when values are given to the sample size, expenditure of resources per observation, and the adjustment factor for the sample mean. An optimal information-collection system is one that yields minimum total cost of sampling and errors. A methodology is developed for use in the design of optimal information-collection systems. Although optimal values cannot be derived for general models, solutions are determined for a class of error cost functions that occur in many Operations Research problems.

Both single and multi-decision sampling problems are examined. It is assumed that errors are linear, quadratic, or square-root functions of the magnitude and sign of the estimation error.

Decision rules are developed for obtaining the optimal values of the controllable variables. Examples are given to indicate model solution applicability and to determine the importance and effect of each control variable on total cost. For each error cost function type, optimal ratios of sampling cost to error cost are derived. Comparisons are made of the relative effectiveness of single and multi-stage models in multi-stage sampling problems.

Microfilm \$2.75; Xerox \$8.80. 194 pages.

ENGINEERING, AERONAUTICAL

IMPROVED SOLUTIONS FOR LAMINAR FLOW NEAR THE TRAILING EDGE OF A FLAT PLATE

(Order No. Mic 60-4991)

Arnold Goldburg, Ph.D.
Princeton University, 1960

This theoretical investigation is concerned with a steady planar process in which an incompressible viscous fluid of infinite extent flows over a flat plate of finite extent which is aligned parallel to the direction of the fluid's oncoming uniform velocity at upstream infinity. Local values of the stream function and pressure are to be de-

termined in a region of interest surrounding the trailing edge point when the Reynolds number based on the plate length and the upstream uniform velocity is large.

The theoretical solutions developed here are approximate ones. Viscous fluid flow at high Reynolds number near a solid boundary is viewed as a particular example of an asymptotic phenomenon (Reference 6). Appropriate transverse quantities are stretched by the order of the square root of the Reynolds number. The stream function and the pressure are expanded in asymptotic series in the inverse of this parameter. Thus, the zeroth order boundary layer solution is considered to be the first term of an asymptotic representation of a solution to the full Navier-Stokes equations.

Dr. Sydney Goldstein (Reference 1) obtained the zeroth order solution in terms of the rectangular Cartesian coordinate system. The initial condition was taken to be the Blasius velocity distribution along the trailing edge ordinate. This solution possesses special deficiencies: 1) It can be valid only in a part of the first quadrant. 2) The predicted transverse velocity is not bounded along the trailing edge ordinate and does not tend to zero at distances far from the plate. 3) The predicted shear is arbitrary at the trailing edge point.

In general, zeroth order solutions representing approximations to the same exact flow field depend upon the system of coordinates in which the Navier-Stokes equations is represented when the asymptotic procedures are applied.

To improve Dr. Goldstein's zeroth order solution, two different coordinate systems are used. The Parabolic coordinate system with origin at the trailing edge point is the most natural one for the problem. The initial condition may then be taken as the Blasius velocity distribution along a perpendicular to the plate erected at a distance upstream from the trailing edge where the influence of the trailing edge can be assumed to be negligible.

The method known as PLK (Reference 23) has shown that a coordinate straining relation likely to improve the zeroth order solution can be obtained by requiring uniformity in the analytic behaviour of the approximate solutions of all orders. This so-determined "Strained" coordinate system turns out to be Parabolic in form.

The zeroth order asymptotic approximation in terms of the Parabolic coordinate system is a definite improvement. The singularity along the trailing edge perpendicular is removed. However, a singularity remains in the neighborhood immediately adjacent to the plate. The use of the Parabolic coordinate system serves to achieve the major purpose at the trailing edge as at the leading edge (References 16 and 21) despite the complicated initial condition.

The "no-slip" condition in the initial velocity profile is responsible for the fact that the parabolic solution does not satisfy the Stokes slow-flow equation in the region immediately adjacent to the trailing edge point and that it does not include within itself a valid first order external flow field solution.

In the context of the asymptotic phenomenon, the crucial question of the extent of the upstream influence of the trailing edge is answered differently by one order of magnitude--of the order of the inverse of the square root of the Reynolds number in the case of Professor Lighthill's method and of the order of the inverse of the Reynolds number itself in the case of the Parabolic coordinates.

Microfilm \$3.20; Xerox \$11.25. 248 pages.

ENGINEERING, AGRICULTURAL

EFFECT OF AN AIR FILM ON SOIL TO TILLAGE SURFACE FRICTION

(Order No. 61-3030)

Floyd Wilber Bigsby, Ph.D.

Iowa State University of Science and Technology, 1961

Supervisors: Clarence W. Bockhop and
Glenn Murphy

The use of fluid films to separate parts which move relative to each other is widely accepted. Air films have been used in some types of bearings and in conveyors.

This study was undertaken to determine the effect of an air film between the soil and a tillage tool on the draft of the tool.

Tests were made on model tillage tools in soil boxes thus permitting more control over test conditions than is possible in field tests. The apparatus consisted of a trolley carrying soil boxes which ran on a 45-foot narrow gage track. The trolley was propelled by an electric motor driving a roller chain through a variable speed gear box. The tool being tested was suspended on load cells mounted on a stationary load frame straddling the track.

Prior to tests, the soil was prepared with a scraper and packing wheels mounted on a separate packing frame. The draft of the tools was determined from strain records taken by an oscillograph which measured the strain in electric resistance strain gages in the load cells.

Four tools, designed for use with air, were tested; however, two of these tools were abandoned because they appeared to be less satisfactory than the other two. The tools used for final comparisons consisted of a tool whose surface was covered with steel sheet containing 0.028-inch diameter holes on an equilateral spacing 0.077 inches apart; a tool whose surface was covered with a steel sheet containing 0.028-inch diameter holes on a rectangular spacing approximately 1/4 inch by 5/16 inch; wire tools constructed from 0.010-inch diameter steel wire and 0.006-inch diameter wire; a tool with a smooth surface. With the exception of the wire tools, all tools had flat surfaces 3 inches long by 4 inches wide. These tools were operated at a slope of 25 degrees to the horizontal with the cutting edge perpendicular to the direction of travel. A 4-inch wide ridge was made in the soil by cutting away the soil on each side. This procedure eliminated edge effects.

Tests were made in three soils: Ida silt loam, Colo silty clay loam and Luton silty clay. The tests covered

the moisture range over which it was possible to work these soils.

The tools were tested using air flow rates ranging from 0 to 69.8 cubic feet per square foot per minute.

In all cases, the draft of a tool using air was greater than the draft of the smooth tool, although only in Ida soil was the increase in draft statistically significant at the 5 percent probability level.

Higher air flow rates may reduce the draft of these tools; however, the power required to supply air at higher rates becomes so great that the over-all power required is greater than the power required for the smooth tool.

Microfilm \$2.75; Xerox \$4.60. 87 pages.

ENGINEERING, CHEMICAL

DIALYSIS TECHNIQUES FOR STUDY OF EMULSIFIER TRANSPORT PHENOMENA IN LATEX

(Order No. 61-3296)

Edward Graham Bell, Ph.D.

Case Institute of Technology, 1961

A hypothesis is proposed and verified experimentally that interphasal transport processes involving ionic surfactants in latex can be studied in a compartmented system. The components of a complex colloid, or fractions thereof, are isolated in cells which are partitioned by membranes selectively permeable to some of the components. Procedures are described for closing material balances using precision radiotracer techniques developed especially for this type of experiment.

Studies are reported for segregation of a polystyrene latex in a two-compartment dialysis cell where particular attention is given to the transfer processes which establish equilibrium among micellar, soluble and adsorbed soap. In this simple case, the experimental results can be confirmed by other independent methods and data, which overlap this technique in studying the same phenomena. The results demonstrate that the membrane in the compartmented system does not alter the equilibria prevailing in the completely mixed latex.

A number of applications are suggested for use of this method in studying transfer processes in more complex colloids where alternative techniques are inapplicable.

Microfilm \$2.75; Xerox \$4.80. 92 pages.

THE TRANSIENT STARTUP BEHAVIOR
OF A LIQUID-LIQUID EXTRACTION
PULSE COLUMN

(Order No. 61-3029)

John Carlton Biery, Ph.D.
Iowa State University of Science and Technology, 1961

Supervisor: David R. Boylan

The transient startup behavior of a liquid-liquid extraction pulse column was investigated experimentally and mathematically. The purpose of the research was to develop methods for estimating the transient response curves and times required to reach steady state.

Experimental data were obtained on a pulse column 20 feet high and 3 inches in inside diameter. The plate section of the column contained 79 plates spaced $2\frac{1}{4}$ inches apart. A tributyl phosphate/Varsol-nitric acid-water ternary extraction system was used.

The column system was operated for approximately 200 hours to obtain the experimental transient response curves. Each run lasted from 4 to 9 hours. Transients were introduced as step changes in the nitric acid feed concentration after the column had been operating under acid free steady state conditions. Raffinate concentration versus time curves were determined continuously with a continuous electrolytic conductivity detector and recorder.

The mathematical transient response curves were obtained from the solution of mathematical models describing the column behavior. Ordinary differential equations were formed by either reducing the partial differential equations describing the column behavior to finite difference form or by forming transient material balances over finite sections of the column. Nine different mathematical models or combinations were formed.

The partial differential equations describing the system behavior were derived on the basis of plug flow down a packed counter-current extraction column. Longitudinal diffusion and mixing were neglected.

The sets of ordinary differential equations were integrated on both analog and digital computers. For the analog computer the equilibrium curve was linearized. For the digital computer the non-linear equilibrium curve was used and expressed in polynomial or tabular form. A modified Runge-Kutta numerical procedure was used in the integration of the sets of equations. The largest number of equations integrated in one set was 128.

The response curves from the various mathematical models were compared with those from experimental data. Three of the models produced good estimates of the time required to reach steady state. The dead time portion of the curves was reproduced by two of the material balance models when the column subdivision was sufficiently refined. The models which were formed by substituting an interlocking finite difference representation for the height derivative produced curves which oscillated during the dead time period but which reproduced the experimental data fairly well thereafter.

The mathematical simulations would have been improved if a longitudinal turbulent diffusion term had been included. The experimental data indicated that significant longitudinal diffusion occurred.

Microfilm \$3.15; Xerox \$11.05. 243 pages.

A STUDY OF THE LONGITUDINAL DISPERSION
OF GASES IN LAMINAR FLOW
IN A CIRCULAR TUBE

(Order No. 61-3254)

Anthony Bournia, Ph.D.
University of Pittsburgh, 1961

The longitudinal dispersion coefficient of a finite slug of gas has been measured at various velocities by using the gas together with 1,3-butadiene which absorbs in the ultraviolet region and then passing the dispersed slug through a narrow beam of ultraviolet light of wavelength 250 m μ . The finite slug alternately uses butadiene and other gases.

Both the gravitational effect and also the applicability of Taylor's theory in the laminar flow region have been studied. Three gases were used in the experiments: helium, nitrogen, and argon which showed marked gravitational effects due to their density difference, while a fourth, 1-butyne, which has the same molecular weight as butadiene had no effects. A pronounced natural convection is shown to be caused by gravity where Taylor's theory no longer applies. In addition, the phenomenon of the instability of flow due to density differences is observed in the process of the experiment for low flows and is shown by both the data of the finite slug and single interface.

With the experiments of the two isomeric gases of equal molecular weights, namely 1,3-butadiene and 1-butyne, the range of applicability of Sir Geoffrey Taylor's virtual coefficient of diffusivity has been discussed. The experimental observation that the peak mean concentration passes through a maximum value with velocity has been explained by considering the relative rates of dispersion by convection, longitudinal diffusion, and radial molecular diffusion.

Microfilm \$2.75; Xerox \$6.60. 140 pages.

MASS TRANSFER IN DROPS
UNDER CONDITIONS THAT PROMOTE
OSCILLATION AND INTERNAL CIRCULATION

(Order No. Mic 61-2426)

Gus Louis Constan, Ph.D.
Case Institute of Technology, 1961

Single drops supported on hypodermic tubing have been studied in a wind tunnel to determine the effect of drop oscillation on mass transfer. The systems studied for the case where internal resistance controls consisted of absorption of SO₂ gas by drops of glycerine, propylene glycol, and ethylene glycol. The results can be expressed in terms of effective diffusivity.

No significant effect was noted in glycerine, whereas the glycols gave effective diffusivity values of 2-8.

Frequencies, amplitudes, and internal circulation velocities in the drops were studied by cinematography, and are compared with predicted magnitudes.

The effect of oscillation on external mass transfer coefficients was studied by sublimation of naphthalene

spheres. In the cases where the vibrational velocity was less than the stream velocity, no effect was noted; this is in agreement with heat transfer studies.

A technique has been developed for studying the effect of internal circulation on effective diffusivity, using forced circulation through a drop suspended on hypodermic tubing. A "pseudo-film thickness" is determined as a function of circulation velocity, and presents a means of predicting effective diffusivity. This technique has been demonstrated for the system $\text{SO}_2\text{-H}_2\text{O}$, giving results in fair agreement with the correlation of Garner and Lane.¹⁷

Microfilm \$2.75; Xerox \$6.80. 145 pages.

NUMERICAL SOLUTION FOR CERTAIN KINETIC MODELS FOR FIXED BED OPERATION

(Order No. 61-3098)

David Owen Edwards, Ph.D.
The University of Wisconsin, 1961

Supervisor: Associate Professor Edwin N. Lightfoot

A numerical scheme is presented for the frontal analysis of a multicomponent system in a chromatographic column for two kinetic models. These models assume local equilibrium throughout the column in one case and a linearized mass-transfer resistance in the other. Axial diffusion and axial mixing are assumed negligible.

The scheme was programmed in "ForTran" and several cases where analytical solutions were available were used to test the models. Excellent correlation between the analytical and computed results was obtained. Only when the analytical solution demanded a discontinuity behind the advancing front did the correlation become poor. When the scheme was used for elution, the computed results became unstable.

The program is written to accept arbitrary equilibria which may be compiled independently of the main program. These equilibria may be interfering. Also, a number of different numerical schemes may be tested by this program.

Microfilm \$2.75; Xerox \$7.00. 148 pages.

EFFECTS OF SONIC VIBRATIONS ON HEAT TRANSFER

(Order No. 61-3261)

Joseph Harrison Gibbons, Ph.D.
University of Pittsburgh, 1961

Supervisor: Gerald Houghton

Some effects of audible sonic vibrations on heat transfer from platinum wires to water have been investigated. The three regions of heat transfer of interest were those of subcooled single-phase heat transfer, saturated nucleate boiling, and saturated film boiling. The heat-transfer surface was a 0.005 in. (or 0.008 in.) diameter annealed platinum wire, held between two 1/4 in. diameter nickel elec-

trodes, and immersed to a given depth below the liquid surface. The wire and heat-transfer medium was contained in a 1 ft. length of 3 in. diameter glass pipe. The water supply was supplied by continuously circulating water from a constant temperature tank. The bottom of the glass column contained a loosely fitting Teflon piston sealed by a silicone rubber diaphragm. The piston was vibrated by an electro-dynamically-driven vibrator at frequencies in the range 20 to 2,000 c/s. A microscope and cathetometer were used to measure the amplitude of the vibrations at each frequency. The water level was held constant at 7 in. above the piston. The platinum wire was heated by a continuously adjustable d.c. power supply providing 0 to 16 volts at 0 to 8 amperes with a ripple of less than 0.1 per cent. A Wheatstone bridge, of which the platinum wire was a part, was balanced to obtain the wire temperature. The precision fixed resistors in the bridge circuit were thermostated to avoid errors caused by ambient temperature changes. The current through the wire was measured by a precision multi-range ammeter. Heat-transfer coefficients (h) were significantly improved in some cases by sonic vibrations. The major conclusions which may be drawn from this work are listed below:

(1) Heat-transfer rates are significantly improved in the audible frequency range. The heat-transfer rates are improved about 30 per cent in film boiling, as much as 300 per cent in nucleate boiling, and more than 450 per cent with no boiling.

(2) Peaks in heat-transfer rates are observed which are not due to experimental error or to sonic power input.

(3) The improvements in heat-transfer rates due to vibration are greatest in subcooled water and the increase in h becomes greater as the temperature difference between the wire and bulk fluid (ΔT) decreases when the bulk temperature is held constant.

(4) In bulk nucleate boiling, the increase in h due to vibration becomes larger as ΔT decreases.

(5) In bulk film boiling, the increase in h due to vibration seems relatively independent of ΔT .

(6) When two water flow rates are used, the increase in h due to vibration is essentially the same for both flow rates.

(7) The improvement in heat-transfer rates is not significantly affected in the no-boiling region by wires of different diameter.

(8) The improvement in heat-transfer rates in the no-boiling region is essentially the same for horizontal and inclined wires.

(9) The depth of the wire below the water surface has no apparent effect on the heat-transfer rates in the system used.

(10) Sonic vibrations change the boiling curve in a quantitative manner by decreasing the ΔT at a given heat flux.

(11) The onset of film boiling can be prevented by sonic vibrations.

(12) Film boiling can be reverted to nucleate boiling with a sound field.

(13) Sonic vibrations allow a higher ΔT and a higher heat flux to be reached before physical burnout occurs.

Microfilm \$2.75; Xerox \$7.60. 161 pages.

THE DYNAMICS OF A PACKED GAS ABSORBER BY FREQUENCY RESPONSE ANALYSIS

(Order No. Mic 61-2873)

Robert I. Gray, Ph.D.
The University of Tennessee, 1961

Major Professor: John W. Prados

The unsteady state behavior of physical gas absorption in a packed bed was studied by comparing the results of experimental frequency response tests of such a system with theoretical frequency responses determined for several postulated flow models.

The absorption column consisted of a 6-inch ID, Pyrex pipe packed to a depth of 5.12 ft with 5/8-inch ceramic Raschig rings. The gas phase was a mixture of carbon dioxide and air, while the solvent was water. Both phases were handled in open systems.

The frequency response tests were conducted by introducing a gas mixture with a sinusoidally varying carbon dioxide concentration to the inlet of the column and measuring the resulting steady state concentration wave at the column outlet. The concentration sinusoid was generated by mixing with a constant flow air stream the carbon dioxide flow from a sinusoidally varying linear valve specifically designed for the application. The sinusoid generator was capable of frequencies of 0.1 to 15 cycles/min.

The gas phase steady state concentration sinusoids at the inlet and outlet of the column were measured continuously with specially designed, high speed thermal conductivity cells and were recorded with a single channel oscillograph. The dynamic response of the column was tested for liquid phase flow rates of 222, 55, and 0 lb moles/hr-ft² at each of three gas phase flow rates (nominally 1, 10, and 20 lb moles/hr-ft², corresponding to Reynolds numbers of 30, 300, and 600, respectively). The responses of the packing section alone were determined from the total column responses by deducting the effects of the column inlet and outlet sections which were evaluated from frequency response tests of a mock-up of these sections.

The experimental frequency response results obtained for a spectrum of concentration sinusoid frequencies at each set of column operating conditions were expressed graphically in Bode plots (phase shift and logarithm of the amplitude ratio versus logarithm of the sinusoid frequency).

Theoretical frequency responses for the packing section were calculated for three flow models: a "slug flow" model which presumed no radial velocity gradients, a "mixing cell," and an "axial diffusion" model which attempted quantitative descriptions of the packing section mixing or dispersion phenomena.

The experimental results showed that the greatest portion of the column response was associated with the inlet and outlet sections for all the gas flows tested.

Comparison of the theoretical and experimental packing section frequency responses indicated that, while the "slug flow" model most closely described the absorption dynamics, no model was completely satisfactory in this respect. The deviations of the experimental responses from those of the "slug flow" model were attributed to mixing of the gas phase in the packing section. The presence of these dispersion effects was clearly demonstrated in the

nonabsorption (dry packing) tests. While neither the "mixing cell" nor the "axial diffusion" models adequately described the observed responses, it was established that the relative degree of mixing was considerably larger than had been previously reported for gas flow in packed beds.

The applicability of a flow model could not be established from comparison of experimental and theoretical phase shifts as all models resulted in similar data which were, generally, in good agreement with the observed values.

The effect of column operating conditions on the degree of mixing was masked by an apparent complex interaction of these variables and by the lack of a satisfactory single mixing parameter.

Microfilm \$3.95; Xerox \$13.95. 306 pages.

AN ASYMMETRIC RESIDENCE-TIME DISTRIBUTION MODEL FOR FLOW SYSTEMS

(Order No. 61-3307)

Robert Bartlett Hovorka, Ph.D.
Case Institute of Technology, 1961

A mathematical model, which approximately represents internal mixing due to turbulence, non-uniform velocity profiles, etc. in flow systems, is developed. This model is based on a suitable combination of perfectly mixed and plug flow vessels arranged to account for both live and dead-flow volume. The model is defined by four parameters, the values of which completely define the mixing within the model.

Such a model is useful in the study of the steady-state and dynamic behavior of flow systems. The model is confirmed in two ways, by: 1) The representation of the unsteady-state linear residence-time distribution of flow systems and 2) The determination of the steady-state non-linear chemical conversion for a second order kinetic system.

From a mathematical treatment of the model, a general solution for the residence-time distribution of the model as a function of the four parameters is derived; this solution consists of only exponentials and powers of the independent variable. Techniques are presented for the determination of the model and four confirmation examples are described.

Using the model determined from an experimental residence-time distribution, the upper and lower limits on conversion for a second order reaction are estimated. These results agree closely with the actual experimental conversion.

Microfilm \$3.55; Xerox \$12.60. 276 pages.

DEFORMATION CHARACTERISTICS OF
THE ALUMINA-SILICA SYSTEM AT ELEVATED
TEMPERATURES AND PRESSURES

(Order No. 61-3043)

Thomas Donald McGee, Ph.D.
Iowa State University of Science and Technology, 1961

Supervisors: C. M. Dodd and P. Chiotti

This research was conducted to determine conditions under which alumina-silica refractories of commercial purity could be hot pressed to increase their bulk density and to determine the deformation characteristics of the system.

Five compositions were hot pressed at pressures from 3,000 pounds to 10,000 pounds per square inch and at temperatures from 1150° C. to 1600° C. Compositions of approximately twenty, forty and sixty percent alumina were hot pressed. A high duty fireclay and a super duty fireclay of lesser purity were also hot pressed. Pressing was accomplished by transferring an incandescent cube from a furnace to a hydraulic press, quickly applying pressure, releasing the pressure and transferring the pressed cube to an annealing furnace. The cube surface was chilled by contact with the cold mold of the hydraulic press and by the transfer process.

Graphs are presented which show the effect of pressure and temperature on the bulk density of the refractory compositions. The sixty percent alumina composition was too refractory to be pressed at 1600° C. The other compositions were pressed to near true density at temperatures of 1350° C. to 1550° C.

The cube surface temperature was measured and plotted against time for cooling on removal from the furnace. The temperature distribution within the cube was roughly estimated. The temperature of the press mold was measured. The refractory cubes did not heat the press dies hot enough to soften the hardened steel. The chilled layer on the cube surfaces was not excessively thick.

Deformation characteristics were studied by determining the mineralogical composition of quenched samples. The quantity of the crystalline phases was determined by X-ray diffraction using the internal standard technique. Crystalline phases were mullite, cristobalite and quartz. The iron and titania contents of the mullite were determined by X-ray fluorescence methods. The composition and quantity of the liquid phase were estimated by difference between the composition and quantity of the crystalline phases and the total composition. Wet chemical analysis was used to determine the total composition. The cubes were found to be about 60% liquid at the optimum pressing temperature.

Synthetic glasses were made of the estimated compositions. The viscosity of three of these glasses was estimated by measuring the viscosity near the softening point and extrapolating to the hot pressing temperature. The three glasses all had estimated viscosities in the order of 10^6 poises at the pressing temperature. The Shuttleworth and Mackenzie equation for sintering under pressure correctly predicted the approximate pressure required to hot press a glass of 10^6 poises from 75% to 98% of true density in a time of seven seconds.

Conclusions are that alumina-silica refractories can be hot pressed effectively in a cold mold, that the esti-

mates of mineralogical composition and quantity are reasonable, that the effect of impurities is to lower the viscosity of the liquid phase thus lowering the pressing temperature, that the Shuttleworth and Mackenzie equation appears applicable to this system and that the deformation characteristics are predominantly due to Newtonian flow of the liquid phase.

Microfilm \$2.75; Xerox \$8.20. 179 pages.

A STUDY OF THE RARE EARTH OXIDES
AS CATALYSTS FOR THE DEHYDROGENATION
OF CYCLOHEXANE USING A PROGRAMMED
TEMPERATURE FLOW REACTOR

(Order No. 61-3269)

Charles Brownell McGough, Ph.D.
University of Pittsburgh, 1961

Supervisor: Gerald Houghton

An investigation has been carried out to determine the catalytic activities of the oxides of lanthanum, cerium, praseodymium, neodymium, and samarium for the dehydrogenation of cyclohexane. Extensive temperature-conversion data have been obtained for all catalysts by means of a programmed temperature flow reactor in which product gas composition is continually determined in a Sr-90 ionization detector system. The apparatus is capable of rapid and accurate catalyst evaluation, offering several significant advantages over other experimental techniques.

Both unsupported rare earth oxides and oxides impregnated on alumina have been evaluated. The unsupported catalysts are active in the range 430-530° C, evaluated on the same feed rate/surface area basis ($F/A = 0.0184$ cc/m²; feed composition - 7.2 mole % cyclohexane in nitrogen). Although the supported oxides are considerably more active on an equal weight or equal volume basis, on an equal area basis they are less active, since their active temperature range is 470-570° C. The activation energies determined for both supported and unsupported rare earth oxides fall in about the same range, 32 to 39 kcal/g-mole. In general, the rare earth oxides have been found to be less active than oxides of the transition elements.

No observable correlation exists between the paramagnetic susceptibilities or crystal structures of the rare earth oxides, and their relative catalytic activities. Although some of the rare earths are strongly paramagnetic, their paramagnetism arises from unpaired electrons in the 4f shell, which is effectively screened from participating in the catalytic process by the 5s and 5p electrons. Thus, unlike the transition elements, their paramagnetism and catalytic activities are apparently unrelated. Four different rare earth oxide crystal structures were compared and found to be indistinguishable in catalytic activity. No observable differences were found between the A, B, and C modifications of the sesquioxides, and the rutile structure of CeO₂. These modifications have similar interatomic spacings, but the metal atoms in each are differently coordinated, which, since their activities are equal, seems to indicate that the bulk crystal field does not greatly influence this catalytic mechanism. The general

similarity in catalytic activity exhibited by these oxides, including a non-stoichiometric Pr_6O_{11} - Pr_2O_3 catalyst, points to a covalent bonding adsorption mechanism involving the 5 s or 5 p electrons.

Microfilm \$3.25; Xerox \$11.25. 249 pages.

CATALYTIC OXIDATION OF CARBON MONOXIDE AT LOW CONCENTRATIONS

(Order No. 61-3141)

Avinash G. Mulay, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Olaf A. Hougen

A reaction model for the catalytic oxidation of carbon monoxide in air at low concentrations has been established.

A commercial catalyst, hopcalite, consisting of MnO_2 , CuO , Co_2O_3 , and Ag_2O was used in this investigation. This catalyst (20 U.S. Standard mesh size) exhibited constant catalytic activity even after 50 hours of use.

The experimental data were taken at atmospheric pressure and temperatures of 60°, 72°, and 82°C. At each temperature the rates of catalytic oxidation were measured at initial carbon monoxide concentrations of 1, 1.5, and 2%.

Rates of reaction were found to increase with the extent conversion of carbon monoxide, apparently the reaction was catalyzed by the formation and adsorption of carbon dioxide.

The rate constants were determined by means of an IBM-704 digital computer. The data were correlated with less than 10% average error.

It was found that the adsorption equilibrium constants for both carbon monoxide and carbon dioxide decreased with increase in temperature.

This investigation is pertinent to the design of after-burners for removing carbon monoxide from exhaust gases of internal combustion engines.

Microfilm \$2.75; Xerox \$4.00. 75 pages.

AN EVALUATION OF THE SORPTIVE AND CATALYTIC BEHAVIORS OF TYPES 4A AND 5A MOLECULAR SIEVES WITH METHANOL AND N-BUTANOL

(Order No. 61-2915)

Charles Ronald Price, Ph.D.
Virginia Polytechnic Institute, 1958

It was the purpose of this investigation to evaluate the sorptive and catalytic behaviors of Types 4A and 5A molecular sieves with methanol and n-butanol.

Adsorption isotherms were determined for methanol on Types 4A and 5A molecular sieves, and for n-butanol on Type 5A molecular sieves. The temperature of the system when methanol was tested was 66 °C (151 °F), and when n-butanol was tested 120 °C (248 °F). The adsorption isotherm for n-butanol with Type 5A molecular sieves showed

that the adsorbate concentration became independent of pressure at approximately eight inches of mercury, absolute pressure. The adsorption isotherms for methanol with Types 4A and 5A molecular sieves showed that the adsorbate concentration increased over the entire range from zero to 25 inches of mercury, absolute pressure. When these isotherms were evaluated by Langmuir's, Freundlich's, and the general adsorption equations, the results indicated that the adsorbate concentrations calculated by Freundlich's equation showed better agreement with the experimentally determined values than did either of the other two equations.

A series of dynamic, fixed bed sorption tests were conducted using both types of molecular sieves and various feed materials including methanol, n-butanol, mixtures of these alcohols, iso-octane, n-hexane, mixtures of these hydrocarbons, and n-heptane. Materials found to be present in samples of liquid effluent from tests using a mixture of alcohols as feed included mixed butenes, oxygenated compounds, mixed ethers, methanol, water, and n-butanol. Materials in samples of gas effluent from tests using a mixture of alcohols as feed included hydrogen, nitrogen, oxygen, carbon dioxide, methanol, dimethyl ether, mixed butenes, pentene, pentane, and methane.

From results of the dynamic tests it was concluded that methanol and n-butanol vapors cannot be separated by molecular sieves, because they are decomposed by the catalytic action of the molecular sieves. Also, Type 5A molecular sieves decomposed more of the n-butanol-methanol feed mixture than did Type 4A molecular sieves. Tests with Type 5A molecular sieves and n-butanol showed that the amount of n-butanol decomposed increased with increasing temperature.

Results of dynamic tests using hydrocarbons as feed materials with Type 5A molecular sieves indicated that iso-octane, a branch-chain hydrocarbon, was partially decomposed, whereas n-hexane and n-heptane, straight-chain hydrocarbons, were not.

Microfilm \$3.80; Xerox \$13.30. 293 pages.

REACTION RATES IN FLUID SYSTEMS CATALYZED BY SOLID PARTICLES IN FIXED BEDS

(Order No. 61-3153)

Devabhaktuni Ramaswami, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Olaf A. Hougen

The purpose of this investigation is to aid in transforming the highly subjective and qualitative approach to chemical reactions in fluid systems to a more objective and quantitative approach. This investigation is limited to fluid reactions catalyzed by solid particles in fixed beds. Mathematical models are postulated to describe the kinetics of the reactions. The adequacy of these models to reproduce the experimental data is tested. This development is made possible by the application of high speed digital computers.

Methods of calculating the drops of temperature and partial pressure between the bulk gas stream and the

exterior surface of the catalyst pellet are described. These methods are based on recent correlations of published data. Nomograms based on the properties of the system are presented for the evaluation of these drops. Fortran statements, which are suitable for use with high speed digital computers, are written for these calculations and checked against the performance of the IBM 650 computer.

Specific illustrations of external temperature and partial pressure drops are indicated for 14 investigations reported in literature. Variations of these drops with mass velocity are presented for the hydrogenation of propylene over a nickel catalyst and for the oxidation of sulfur dioxide over a platinum catalyst.

Methods of evaluating corresponding gradients of partial pressure and temperature within the catalyst pellet are also indicated.

Numerical methods using the IBM 704 computer for evaluation of rate equations at interfacial conditions are presented. These methods are iterative and proceed stage by stage by reducing the sum of squares of residuals of observed and calculated values. Either initial rates or integral conversions obtained under isothermal conditions or non-isothermal conditions may be correlated directly to obtain rate equations. Since the relationship between rates and independent variables (temperature and partial pressures) is nonlinear more than one solution may be available consistent with minimum sum of squares. Consequently this possibility must be explored before reaching any definite conclusion about the apparent mechanism and corresponding rate equation.

The experimental data reported on vapor-phase hydrogenation of olefins over a nickel catalyst and vapor-phase esterification of acetic acid with methyl, ethyl and n-propyl alcohols over silica gel are re-evaluated using the above methods. The correlations obtained reproduce the experimental data better and are in agreement with the postulated reaction models.

Microfilm \$3.65; Xerox \$12.85. 283 pages.

DIFFUSION AND FLOW OF GASES IN POROUS CATALYSTS

(Order No. 61-2977)

Leonard Benjamin Rothfeld, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Charles C. Watson

Measurements of diffusion and flow of gases within porous catalysts shed light on the transport factors which may determine the over-all reaction rate in heterogeneous catalysis. In commercial catalysts, the pore diameter is often of the same order of magnitude as the mean free path between intermolecular collisions. When catalyst particles are produced by consolidating grains which are themselves porous, two distinct pore structures are superimposed, the macropores among the grains and the micropores within the grains. This study aimed to uncover the mechanism of diffusion and flow in the intermediate range between Knudsen and bulk transport and to unravel the roles of the two pore systems, with the goal of developing

a means of estimating the effective diffusion coefficient from minimal experimental data.

Flow and diffusion data on single pellets of a commercial alumina catalyst support were taken at room temperature and at pressures between 200 and 700 mm Hg. Flow rates of helium, hydrogen, nitrogen, argon and carbon dioxide were measured by the Rigden-Blaine method; a pressure difference was placed across a pellet in a closed system; and the rate of decrease of the pressure difference was observed. The data, which cover the range of mean free paths currently of industrial interest (5×10^{-6} to 7×10^{-5} cm), are correlated by well-known equations for flow through porous media in the intermediate range.

Rates of steady, binary counterdiffusion were determined by analyzing two initially-pure gas streams which had flowed past opposite faces of a pellet at equal pressures and measured flow rates. The five systems were helium versus nitrogen, argon, propylene, isobutane and neopentane. In each system, the two fluxes were unequal, but the flux ratio was independent of pressure. Surface transport was negligible. A new theory was evolved to describe diffusion in the intermediate range, taking into account the absence of equimolar counterdiffusion. The results indicate that the flux ratio alone cannot be used as a criterion for establishing the diffusion mechanism.

The pore-size distribution shows two distinct maxima at pore diameters of 120 Å and 1.25 microns. Analysis of the experimental results in terms of the pore-size distribution indicates that the macropores among the grains serve as distribution channels for reactants and products, while the micropores within the grains provide most of the surface area. Equations are given for estimation of the effective diffusion coefficient and the flow constants. The implications of these results are discussed with regard to surface transport, diffusion into the micropores, and possible internal pressure gradients accompanying chemical reaction.

Microfilm \$5.10; Xerox \$18.00. 400 pages.

A FUNDAMENTAL APPROACH TO THE DEVELOPMENT OF PORCELAINS HAVING LOW FIRING SHRINKAGE

(Order No. Mic 61-2854)

Robert Kenneth Ware, Ph.D.
The Ohio State University, 1961

The effect of composition on the dimensional changes during the firing of porcelains was investigated. Bulk volume, true volume, and weight changes during firing to various temperatures were determined for seventeen raw materials. From these data and data from literature, predictions were made of the true volume changes during the firing of various raw material combinations. Bulk volume changes during firing were determined for multi-component bodies designed on the foregoing basis. Bodies containing (1) spodumene, (2) kyanite, and (3) kyanite and BaSiO_3 showed promise as possible low-shrinkage porcelains. Although low-shrinkage porcelains can be developed with raw materials which tend to produce a large bulk expansion, it was concluded that reactions which exhibit a true volume expansion with no accompanying bulk

expansion are more desirable. Although the true volume change during firing is an important consideration in developing low-shrinkage porcelains, it was found that the consideration of unfired density and fired porosity is equally important. Predictions of true volume changes during firing based on the expected thermal reactions and specific gravity data were found useful in many cases.

Microfilm \$2.75; Xerox \$5.20. 103 pages.

ENGINEERING, CIVIL

A STUDY AND EVALUATION OF LOCAL HIGHWAY PLANNING IN WISCONSIN

(Order No. 61-3084)

Kurt Walter Bauer, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Lloyd F. Rader

The purpose and general objectives of this study were:

1. To determine the extent to which municipalities in Wisconsin have actually prepared long-range plans for the development of integrated urban street and highway systems and have actually attempted to implement these plans through legislative action and administrative practices.
2. To determine the effectiveness of these plans and plan implementation devices in achieving integrated urban highway systems.
3. To isolate and analyze any strengths or weaknesses in the existing local highway planning processes.
4. To outline a method of effecting the attainment of current and realistic local highway system plans in urban areas and suggest possible changes in the legislative framework or administrative practices which might improve the local highway planning processes, with particular emphasis upon possible functions of the Wisconsin State Highway Commission in the process.

The study was based upon an analysis of a statewide local planning inventory covering 32 cities and villages in all including all municipalities of 25,000 and over population in the state. Utilizing the results of this inventory, six cities were selected for more intensive study, and the following research procedure applied:

1. All existing plan documentation and plan implementation devices, along with copies of the official proceedings of the local plan commission and common council, were collected from each city studied. This assembled data was reviewed and analyzed for possible impact on the highway planning process as well as to provide a measure of the over-all status of local planning in each city studied.

2. For each city having a highway plan the extent to which this plan had been actually implemented through major highway construction undertaken since the adoption of the plan was then determined by means of a series of overlay maps. The overlay map process clearly indicated any serious discrepancies between the adopted local highway system plans, actual major highway construction, and established Federal Aid System routes. Each major discrepancy indicated by the overlay map process was regarded as evidence of a possible breakdown in the local highway planning process.
3. Each such possible breakdown was then investigated by means of structured interviews directed toward an analysis of the local highway planning process. Interviews were held in each case with individuals active in the local planning process, including engineers, planners, elected officials, and recognized community leaders.
4. The results of the structured interviews were then summarized and analyzed in light of the factual information provided by the collection and analyses of the plan documentation, the official proceedings, and the overlay maps. This analysis was made on an individual city by city basis and a body of material was thus created from which general conclusions were drawn about the specific fact situations involved in each case. In addition, because of the full range of planning experience represented by the cities studied, generalizations were drawn from the same body of material which are believed applicable on a statewide basis.

From the research findings generalized conclusions pertinent to the stated purpose and objectives of the study were made. The study found that the existing local highway system plans are not serving as statements of mutually agreed upon long-range objectives to guide and coordinate highway plan implementation activity at all levels of government toward the ultimate attainment of integrated urban highway systems, and that this highly unsatisfactory situation represents a serious weakness in the local highway planning process in Wisconsin. Five major factors were found to be contributing to this unsatisfactory situation and a detailed planning procedure is recommended to overcome these factors and permit the preparation of cooperatively adopted and jointly implemented local highway system plans in Wisconsin.

Microfilm \$6.45; Xerox \$22.95. 506 pages.

ELECTROKINETIC-POTENTIAL FLUCTUATIONS PRODUCED BY TURBULENCE AT A SOLID-LIQUID INTERFACE

(Order No. Mic 60-6796)

Gilbert Jean Binder, Ph.D.
Colorado State University, 1960

When an electric double-layer arises at a solid-liquid interface, there exists a net electric charge Q in the liquid phase. It is shown that a turbulent flow field

produces electrokinetic-potential fluctuations ψ . Molecular diffusion is shown to be negligible compared to the electrical conduction if the eddies considered are larger than the diffuse layer thickness $1/\kappa$. The main contribution to the potential fluctuations is shown to be due to the transport of the net mean-charge density \bar{Q} by the velocity fluctuation \underline{u} of the liquid having a conductivity σ . The approximate equation describing the relationship between ψ and \underline{u} is

$$\sigma \Delta \psi = \underline{u} \bar{Q}$$

if $n_M \tau \bar{U}_x \ll 1$

where n_M is the largest wave number of the eddies considered, τ is the relaxation time of the liquid and \bar{U}_x the local mean velocity. If the ratio $\frac{u'_\theta}{u'_x}$, where u'_x is the R.M.S. value of the transverse component and u'_x is the R.M.S. value of the longitudinal component of the velocity fluctuation, is small, the spectrum of u_x (E_{u_x}) is related to the spectral distribution of the potential fluctuations by

$$E_{u_x}(n) = \left(\frac{\sigma}{\bar{Q}}\right)^2 n^2 E_\psi(n)$$

The electrokinetic-potential fluctuations produced by turbulent motion of an aqueous solution in a straight circular glass pipe were measured for Reynolds numbers up to 8×10^4 . The conductivity of the aqueous solution was 4×10^{-6} mhos/cm. The order-of-magnitude of the diffuse layer thickness was 5×10^{-6} cm and that of the product $n_M \tau \bar{U}_x$ was 10^{-5} .

The results of the measurements of the potential fluctuations obtained by varying the spacing of the wall electrodes (by which the potential fluctuations were sensed), the Reynolds number and the distance of the electrodes from the pipe entrance were consistent with what was to be expected on the basis of the existing knowledge on turbulence.

The spectrum of the longitudinal-velocity fluctuations E_{u_x} as calculated from E_ψ shows satisfactory agreement with previous measurements made by Laufer with a hot-wire anemometer. The ratio $\frac{u'_x}{U}$ at the distance of ap-

proximately 5×10^{-6} cm is computed and found to be equal to 10^{-5} . Microfilm \$2.75; Xerox \$6.60. 136 pages.

ISOLATION AND INVESTIGATION OF A LIME-MONTMORILLONITE REACTION PRODUCT

(Order No. 61-3038)

George Harrison Hilt, Ph.D.

Iowa State University of Science and Technology, 1961

Supervisor: Donald T. Davidson

During previous research by this writer it was noted that mixes of lime and a soil rich in montmorillonitic clay mixed with water above the liquid limit would within sev-

eral days apparently be dried below the liquid limit with no loss in weight. In order to determine what was occurring, a portion of this sample was subjected to x-ray diffractometer analysis. Strong indications of a new reaction product were observed but the product could not be found under the microscope.

The research undertaken was (1) to investigate various lime-soil-water systems varying each of the three parameters one at a time to determine the best phase relationships for growing euhedral crystals of sufficient size to be observed under the microscope, (2) to isolate these crystals, and (3) to determine their physical and chemical properties.

The systems investigations were accomplished by preparing a large number of mixtures and allowing them to cure for periods from two days to eight months before examination. Isolating the crystals was done under the microscope, and the determination of their properties was undertaken primarily by microscopic and x-ray methods.

Using the x-ray diffractometer it was determined that the crystalline product is produced in greatest abundance in montmorillonitic clays mixed with lime at moisture contents exceeding the liquid limit. Although soil montmorillonite gave quicker results, the larger crystals were formed in mixes using bentonite.

These crystals are hexagonally shaped, platelike, transparent, and colorless with a specific gravity equal to $2.07 \pm .01$. They were uniaxial, optically negative, and the index of refraction of the ordinary ray (perpendicular to 00.1) was equal to $1.548 \pm .002$.

Single crystal rotation and Weissenberg x-ray photographs proved that they belonged to the rhombohedral division of the hexagonal system in space group D_3^6 or C_3^6 . The unit cell dimensions were determined by powder x-ray photographs and for the hexagonal cell are $a_0 = 5.7550 \text{ \AA}$ and $c_0 = 46.654 \text{ \AA}$. For the rhombohedral cell the corresponding unit cell has parameters of $a = 15.902 \text{ \AA}$ and $\alpha = 20.850 \text{ \AA}$. The four strongest lines from powder film data and the corresponding Miller indices from Weissenberg data are 7.59 \AA , 00.6; 2.87 \AA , 11.0; 2.30 \AA , 20.8; and 3.85 \AA , 01.8 and 00.12.

An exact quantitative analysis of the crystals could not be made; however, it is likely that the composition approaches $4\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot 13\text{H}_2\text{O}$ and may contain some carbon dioxide in solid solution or silica in the lattice. The rhombohedral unit cell would contain one molecule and the hexagonal cell six molecules of this composition.

Microfilm \$2.75; Xerox \$4.00. 75 pages.

PHYSICAL AND MINERALOGICAL FACTORS IN STABILIZATION OF IOWA SOILS WITH LIME AND FLY ASH

(Order No. 61-3044)

Manuel Mateos, Ph.D.

Iowa State University of Science and Technology, 1961

Supervisor: Donald T. Davidson

The purpose of this investigation was to study the physical and mineralogical factors or variables that may influence the stabilization of Iowa soils with lime and fly ash.

Four natural soils, a dune sand, a friable loess, a gumbotil and an alluvial clay; eight different fly ashes; and five limes were used in the studies.

Test specimens 2 in. high by 2 in. diameter were prepared by compaction from the different mixtures made with the proper moisture content. Stability evaluations were made, based on unconfined compressive strength of test specimens subjected to various curing and simulated weathering treatments.

The effects on stability studied included (1) moisture-density and moisture-strength relationships; (2) proportions and amount of lime and fly ash; (3) degree of densification; (4) temperature at time of compaction and during curing; (5) delay of compaction after wet mixing; (6) use of small amounts of chemical additives; and (7) modification of the quality of a fly ash by grinding or by discarding the coarse fraction. Also a comparison was made of soil-lime-fly ash, soil-lime and soil-cement stabilization, which included freeze-thaw testing of selected mixtures.

The test results show that there are great differences in the pozzolanic activity of different fly ashes, and that this activity varies with the type of lime used. The maximum strength occurs generally at a moisture content other than the optimum moisture content for maximum density. The compaction moisture content for maximum strength changes with the curing period; the longer the curing period the higher the moisture content required to give maximum strength. Modified Proctor compaction gives strengths about 100 percent greater than standard Proctor compaction. Compaction should be done as soon as possible after wet mixing with clayey soils; it may be delayed for a day after wet mixing with sandy soils. There is no optimum amount of lime and fly ash for stabilizing all soils. The strength obtained is greatly influenced by the curing temperature; the higher the curing temperature the greater the strength obtained. After one day steam curing, compacted mixtures of soil, lime and fly ash may reach strengths comparable to concrete. The strength gain of friable loess stabilized with lime and fly ash may be accelerated by the addition of small amounts of some chemicals. Sodium carbonate appears to be the most promising chemical. The quality of a fly ash may be improved by grinding or by removing the coarse fraction.

It can be concluded that stabilization of soils with lime and fly ash is a sound method to build road base courses. Fly ash of a high quality should be used. A high quality fly ash with lime, generally dolomitic monohydrate lime preferred, may stabilize a soil to the extent that strengths after 28 days curing are comparable to those of soil-cement (500 to 900 psi) on an economically competitive basis. Compacted mixtures of soil lime, and fly ash withstand the destructive effects of alternate freezing and thawing. Microfilm \$3.25; Xerox \$11.50. 252 pages.

VERIFICATION OF THE YIELD-LINE THEORY BY SMALL SCALE TESTS

(Order No. Mic 61-1907)

Gene Alan Metz, Sc.D.
Washington University, 1961

Chairman: Dr. A. A. Brielmaier

The elastic solution of reinforced concrete slabs is often quite complex and sometimes impossible. The yield-line theory however, offers a relatively simple method for obtaining the ultimate flexural load of a slab without resorting to a great deal of higher mathematics. In this dissertation, the general background and fundamentals of the yield-line theory are first reviewed, then some specific slabs are analysed, and finally, the analyses of these slabs are verified by testing small scale models. Some of the cases have, to the writer's knowledge, never before been treated.

The results of this investigation show:

1. The yield lines are a reality, and ultimate loads can be predicted quite accurately with the yield-line theory.
2. The location of the yield lines may be found by testing small models.
3. The ultimate flexural load for slabs with irregular support arrangements and either uniform or irregular loading may be determined by this theory with the aid of small models.

Microfilm \$2.75; Xerox \$8.20. 176 pages.

ENGINEERING, ELECTRICAL

EFFECT OF SOME MATRIX PROPERTIES OF ELECTRIC NETWORKS UPON COMPUTER SOLUTIONS

(Order No. 61-3027)

Paul Maurice Anderson, Ph.D.
Iowa State University of Science and Technology, 1961

Supervisor: Warren B. Boast

The purpose of this investigation was to express the solution of power flow in linear electric networks in terms of matrix calculus and to derive from these expressions an iterative solution to the power system load flow problem. This required a study of the nature of the boundary conditions used in power system solutions in order to insure a consistent set of equations.

The electric power system is no different in many respects to other passive linear networks. Viewing the problem as that of an n-port network the usual Kirchhoff's law equations apply. The boundary conditions applied to the ports are different than those often encountered in circuit analysis however. These boundary conditions usually take two forms depending upon the nature of the terminal under consideration. At load ports, or those terminals at which power leaves the network, the boundary conditions are usually specified as the power and reactive

power leaving the network. At generator terminals the boundary conditions are usually given as the power and voltage magnitude since these are quantities under direct control of the power station operator. Both types of ports therefore, furnish two constraints per port of a nonlinear nature. In an n -port network one port, usually called the swing generator, is specified in voltage magnitude and phase angle, or its voltage is completely specified. This leaves the voltages at the remaining $n - 1$ ports to be solved for and, since these voltages are complex quantities, requires $2n - 2$ equations in the remaining $2n - 2$ unknowns. Since $2n - 2$ boundary conditions have been specified at these $n - 1$ ports a solution should be attainable.

To effect a solution of these $2n - 2$ equations they were first written as functions of only the voltage components as quadratic forms in matrix notation. This had the advantage of eliminating the current variables from the expressions for power and reactive power and, at the same time, of expressing the power and reactive power in a compact matrix notation. From this notation several iterations suggest themselves and two iterations were fully developed and compared with a third method now in wide use by the industry.

The salient feature of the two iterations developed in this investigation was the simultaneous correction of the voltage components at all ports as contrasted with the port-by-port correction of previous methods. This had the advantage of faster convergence than previous methods but resulted in a longer solution time by requiring a greater number of computations per iteration. One of these iterations displayed greater stability than former methods since it converged for networks which caused the older methods to diverge. It also appears feasible that the iterations studied will converge in about the same number of iterations regardless of the size of the network -- a feature not found in previous methods where the number of iterations increases with system size.

Microfilm \$2.75; Xerox \$4.00. 71 pages.

PROPAGATION IN PARTIALLY DIELECTRIC LOADED PARALLEL PLANE AND TROUGH WAVEGUIDES

(Order No. Mic 61-1898)

Marvin Cohn, D.Eng.
The Johns Hopkins University, 1960

A theoretical and experimental investigation of wave propagation on partially dielectric loaded parallel plane and trough waveguides has shown that hybrid and TE modes can propagate therein. It has been shown that the TE_{10} mode is the dominant mode of the parallel plane line, and that either the TE_{20} mode or the PM_{11} hybrid mode can be made the dominant mode of the trough line. Equations are presented for the field intensities, waveguide wavelength, cutoff conditions, power handling capabilities, wall loss, and dielectric loss as a function of frequency, waveguide dimensions and dielectric constant. In the case of the three preferred modes many of these quantities have been computed and plotted to serve as design curves.

The theoretically predicted characteristics of the TE_{20}

and PM_{11} modes of the trough line have been verified experimentally.

A method of exciting the TE_{20} mode of the trough line has been investigated both theoretically and experimentally. Extremely low launching loss has been achieved by this method.

The analysis has shown that these lines can be designed so that their losses are an order of magnitude less than those of conventional rectangular waveguide and their power handling capacity is an order of magnitude greater.

The results of this study indicate that if the dielectric material is replaced by a ferroelectric material, the parallel plane line would be suitable for the design of a number of electric field controlled devices such as phase shifters, attenuators, modulators, and couplers. Similarly a semiconducting material containing a continuous longitudinal PN junction has possibilities for the design of truly distributed parametric and tunnel diode amplifiers.

Microfilm \$2.75; Xerox \$8.40. 181 pages.

HIGHER ORDER EVALUATION OF THE DIFFRACTION OF ELECTROMAGNETIC FIELDS BY CIRCULAR DISKS

(Order No. Mic 61-2427)

Wilhelm Hans Eggimann, Ph.D.
Case Institute of Technology, 1961

The diffraction of an electromagnetic field by a circular perfectly conducting disk is investigated. Following a method outlined by Bouwkamp, the induced current is obtained as a power series expansion in (ka) (k = wave number, a = disk radius). General expressions for the electric and magnetic dipole moments are obtained. The scattering cross-section and higher order multipole moments are calculated for a plane wave at oblique incidence.

The theory is applied to disks in the transverse plane of a rectangular waveguide. The theory of images is employed to calculate the interaction between the disks, and the disks and the guide wall. The theoretical results are compared with experimentally obtained values.

Microfilm \$2.75; Xerox \$7.40. 159 pages.

GAUSSIAN ANTENNA PATTERNS

(Order No. Mic 61-1906)

Lawrence W. Lechtreck, Sc.D.
Washington University, 1961

Chairman: Professor J. R. Cox

The far field radiation from a circular, axially symmetric, plane phase aperture of Gaussian intensity distribution is given by the integral:

$$g(u, K) = \int_0^1 e^{-K^2 r^2} r J_0(ur) dr$$

This radiation integral is evaluated and graphed as a function of the general radiation angle " u " and the Gaussian

aperture coefficient "K". "r" is the normalized radius. The pattern is nearly optimum in the Tchebyscheff sense.

The theory is applicable to any radiation process governed by the four dimensional, homogeneous, wave equation. It is specifically applied to the determination of the far field radiation from paraboloidal antennas of a diameter much greater than one wavelength. Numerous approximations are made and the related errors are estimated. A typical microwave antenna radiation pattern is evaluated theoretically and experimentally yielding on agreement to ± 0.5 decibel.

Microfilm \$2.75; Xerox \$4.40. 81 pages.

RECIPROCITY CALIBRATION OF ELECTROACOUSTIC TRANSDUCERS IN THE TIME DOMAIN

(Order No. Mic 61-1909)

Arthur Frederick Niemoeller, Sc.D.
Washington University, 1961

Chairman: Professor Jerome R. Cox, Jr.

A method of directly evaluating the impulse response of an electroacoustic transducer is presented. The method is essentially the time-domain analog of the conventional reciprocity method which is carried out in the frequency domain. The transient response of a coupled pair of identical transducers is used to compute the impulse response of either of the pair. A numerical method of obtaining a solution is presented and is shown to be equivalent to the numerical solution of a real convolution integral equation. The approximate impulse response of one member of the pair of identical transducers is obtained first. Then a more precise solution is generated by minimizing the squared error between the actual response of the coupled pair and that one computed by convolving the first approximation to the impulse response with itself.

This method was tried on two pairs of condenser microphones, the microphones within each pair being assumed very nearly identical. A pair of Western Electric 640-AA microphones were tested with the grids both on and off, and a pair of Brüel and Kjaer Type 4131 microphones were tested with the B and K grids on and off and with the grids equivalent to those on the W.E. 640-AA both on and off.

Two solutions were unsatisfactory. They occurred when W.E. 640-AA grids were used on the microphones under test. Three solutions were satisfactory even though they contained a slight negative drift for large values of time. One solution contained no appreciable error in its entire time course.

Microfilm \$2.85; Xerox \$9.90. 219 pages.

SYNTHESIS OF WIDE-BAND AMPLIFIERS BY SUB-BAND TECHNIQUES

(Order No. 61-2999)

Aladdin Norris Perkins, Ph.D.
University of Arizona, 1961

Supervisor: Robert L. Walker

The gain-bandwidth limitations of three-terminal networks are extended to $(m+2)$ -terminal networks where an $(m+2)$ -terminal network is an unbalanced transformerless $(m+1)$ -port with one terminal common to all ports. This extension indicates that $(m+2)$ -terminal networks can have a gain-bandwidth product proportional to the number of driving terminals. Conditions required to obtain a large gain-bandwidth product with a minimum of driving current are obtained. These conditions lead to the sub-band concept. Necessary conditions required of an impedance matrix for it to be an impedance matrix of an $(m+2)$ -terminal network are obtained. Synthesis of a sub-band amplifier is accomplished in two different configurations. A new synthesis procedure is developed to obtain the parallel-connected sub-band amplifier. Synthesis of a required complementing network as a driving-point impedance by presently established synthesis procedures requires many elements. As a result the parallel-connected amplifier is impractical now. A constant-resistance line amplifier is also obtained. This amplifier has a gain-bandwidth product proportional to the number of sub-bands. In addition to realizing power output at the load terminals, a useful power is obtained at the reverse termination of the output line. Losses are considered, and results obtained from an experimental amplifier are presented and discussed. Microfilm \$3.70; Xerox \$12.85. 285 pages.

THEORY OF PARAMETER-PERTURBATION ADAPTIVE AND OPTIMIZING CONTROL SYSTEMS

(Order No. 61-3152)

Vaidyeswaran Rajaraman, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Vincent C. Rideout

Two new forms of parameter-perturbation self-adaptive systems are proposed. In the first scheme a low power model identical to the control system is used as a reference. The information for adaptation is obtained by sinusoidally perturbing the parameters of the model at a high-frequency. This scheme can provide adaptive control only for variations of the system parameters. The second scheme employs multiple models and model parameter perturbations. This scheme is capable of adapting to both variations of the system parameters and the input signal spectrum.

A block-diagram approach to the analysis of systems with small time-variations is developed. This and other methods of time-varying system analysis are used to obtain a linearized mathematical model of the adaptive loop of the system-adaptive scheme. This model called the

parameter correction servo is proposed to explain the adaptive behavior of these schemes. The generality of this concept is demonstrated by obtaining a statistical parameter servo when the input to the system is random and a two-parameter servo for a two-parameter system-adaptive scheme. Similar ideas are used to derive mathematical models of the optimizing loop of a self-optimizing chemical process.

It is shown that parameter-perturbation schemes adjust their parameters along the path of steepest descent of the performance measure-parameter surface.

A system-adaptive scheme is examined for stability. Mathieu-Hill type equations are derived and the stability regions are determined.

A high speed analog computer is used to show experimentally the validity of the mathematical models. Further experiments show that increased speed of system-adaptation is possible with a high frequency perturbation and that system-adaptation is feasible with a random input and random parameter disturbances.

Microfilm \$2.75; Xerox \$7.60. 163 pages.

ANALYSIS OF SOME DIGITAL COMPUTER PROGRAMS BY USE OF SAMPLED-DATA THEORY

(Order No. 61-3279)

Robert Saucedo, Ph.D.
University of Pittsburgh, 1961

Supervisor: Tsung Wei Sze

The objective of this study was to establish a theory and methods by which digital computer programs could be analyzed using sampled-data theory. Both linear and nonlinear programs were considered.

The first step was to establish the general necessary and sufficient conditions for a digital computer program to be physically realizable. Once this was accomplished, two means for synthesizing the physically realizable programs in the form of sampled-data systems were obtained. One was by means of nonsynchronous sampler networks (NSN); the other was by means of pulsed-data networks (PDN). In this study the NSN method was preferred because of its simplicity and flexibility and because it was applicable to both linear and nonlinear computer programs.

The third section of this paper deals with the topics of the discrete phase-plane. Details for the construction of the discrete phase-plane are documented and the resulting portrait interpreted. The various types of singular points are discussed and related to the singular points of continuous systems. For the sake of completeness, limit cycles are discussed. Two theorems dealing with existence of equilibrium points are also established and a criterion to determine the stability of the equilibrium points is provided.

In the fourth section, a wide range of digital computer programs are analyzed by means of the theory and methods established in the first portion of the thesis. In general, the linear programs were analyzed by use of the z-transformation and by means of an analog computer. The nonlinear programs were studied by means of the dis-

crete phase-plane where practical, and by use of an analog computer. The digital processes considered included numerical integration, prediction, the Runge-Kutta method, the Newton-Raphson Method, and linear homogeneous difference equations.

It was shown that many digital computer processes could be simulated by use of a conventional analog computer. The analog simulation provides a very effective means for studying certain types of digital computer programs.

In conclusion, this thesis establishes a theory and provides methods by which digital computer programs can be studied by means of sampled-data theory.

Microfilm \$3.10; Xerox \$10.80. 239 pages.

BEHAVIOR OF ARTIFICIAL NEURAL NETWORKS

(Order No. 61-3168)

David Richard Smith, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Charles H. Davidson

The behavior of artificial neural networks is examined from theoretical and experimental points of view, the techniques of discrete probability theory being extended and verified by model network simulations on digital computers. Both the properties of the constituent cells and the connectivity of the networks as a whole was subjected to extensive variation, and considerable insight is gained as to their effect on network behavior.

First to be considered are non-refractory networks, networks whose cell recovery time is of the same order of magnitude as the time of transmission from cell to cell, so that cells are ready to fire again essentially immediately. A simple and general method of analysis verifies previous results that all-excitatory networks are characterized by a number of steady states, or average firing rates in the network which are capable of maintaining themselves at a constant level. Earlier analysis is generalized to show that the addition of inhibitory interconnections in a network greatly diversifies the combinations of stable and unstable steady states which can exist, as is demonstrated theoretically and verified in the simulations.

If the refractory durations of the constituent cells are made significant the multistability property disappears. It is demonstrated that previous analyses of such refractory systems are in error, in that they neglect the conditional probability problems involved. The simulation studies further show a new phenomenon, an ability of the networks to optimize the distributions of cell firing instants in such a way as to elevate the over-all activity above the chance levels -- in short, to "organize" their activity.

A form of network activity defined as "cycling" is discovered and described, in which exact sets of firing cells become reactivated in an identical form at a later time. This is demonstrated to be a common property of a wide variety of networks, even those with relatively refractive cells (cells with thresholds which vary continuously in time), and those with wide variations in the

refractory durations from cell to cell. The cycling form of behavior may exist in both steady and oscillatory activity patterns, and may exist either in a simple mode, where each cell fires once per cycle period, or in higher modes, where the cells fire more than once per cycle period and at different rates.

The transference of a network from a non-cycling state to a cycling state is defined as locking and may be controlled by the manipulation either of the cell thresholds or of the proportion of inhibitory interconnections. The possible significance of such behavior for short term memory and temporal-to-spatial pattern conversion is discussed in a conclusion, along with a comparison with some physiological recordings on natural cortex material.

Microfilm \$2.75; Xerox \$5.20. 104 pages.

ENGINEERING, MECHANICAL

SIMULATION OF INVENTORY CONTROL SYSTEMS WITH STOCHASTIC REPLENISHMENT TIME

(Order No. 61-3077)

Baldev Krishan Ahuja, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Charles A. Gilpin

Simulation, as applied to industrial systems, is a technique of setting up a logico-mathematical, stochastic, dynamic, functional model of a real situation and then studying the model to arrive at 'descriptive solutions' for the system, i.e., to determine the value of the objective function for any given set of values of the decision variables. The simulation of industrial systems falls into two distinct categories, viz., industrial dynamics type and the queueing type. The response of the system to changes in 'external forces' is studied in the former case while the response to 'internal forces' is studied in the latter case. The problem of inventory control as treated here falls into the second category.

Many of the inventory models are based on shortage costs which is very difficult, if not impossible to assess. Delay in replenishments poses another problem for the satisfactory analysis of inventory control. The methods of dynamic programming can handle only fixed lags in terms of discrete time periods. The application of queueing theory and Markov processes provide some answers to the above problems but such analyses are limited to Poisson demand and exponential replenishment times. From these considerations and due to the added advantages of the simulation as a tool to study transient and detailed behaviour of the system, the simulation of inventory control systems seems desirable.

A simulator was developed for Poisson demand and Erlang's replenishment time with a view to test it by comparing with existing solution. The class of policies used was two-bin continuous review type with no backlog and independent replenishment times. The measures of effectiveness used were customer satisfaction (the ratio of satisfied customers to the total customers), average in-

ventory on hand and number of replenishment orders. For the Poisson-Exponential case the simulation results compared well with the existing solution. The simulator was run for a number of cases and the following results were obtained.

1. If the inventory control levels are modified in the same ratio as average demand (or replenishment time) changes; the customer satisfaction remains in the same range, average inventory on hand changes linearly, number of orders placed remains nearly the same for demand changes and varies inversely for replenishment time changes.

2. If the replenishment time distribution is changed, the customer satisfaction and number of orders increase slightly for higher Erlang's members and average inventory on hand decreases correspondingly.

3. 'Efficient surfaces' (collection of policies giving the same customer satisfaction) are drawn and their use is illustrated by examples.

The approximate method of deriving optimal policies using the lead time demand distribution seems to give satisfactory results under fairly general conditions. This is discussed in an Appendix. The results obtained by this method agree with those obtained by simulation.

Microfilm \$2.75; Xerox \$5.20. 105 pages.

AN INVESTIGATION OF NONLINEAR GEARED TORSIONAL SYSTEMS USING ANALOG TECHNIQUES

(Order No. 61-3088)

John Gustave Bollinger, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Ralph J. Harker

A geared torsional system consisting of a prime mover, gear mesh and load may experience dynamic tooth loads which far exceed the mean driving loads in the system. The excitations which lead to these dynamic forces originate from several sources, but may be classified into two general categories; those excitations which are externally applied to the mass elastic system, and those excitations which originate within the mass elastic system. This dissertation deals with the dynamic tooth loads in geared systems which arise from the effects of the excitations which originate within the mass elastic system or internal excitations.

On the basis of the experimental data and analytical studies reviewed, it is proposed here that the internal excitations are essentially a consequence of the following three factors:

1. Variation in the tooth stiffness as a pair of teeth pass through one cycle of engagement
2. Combined errors in the gear teeth incurred in the manufacturing process
3. Discontinuities in the contact of teeth if the dynamic load exceeds the applied mean load and tooth separation occurs.

This study considers first, the effect of each of the

three internal excitations separately in the meshing of two gears alone. Next, the collective effect of all three sources of excitation are considered in a model of the two gears. Finally, the effect of all three sources of excitation are observed in an entire geared system consisting of prime mover, gear mesh and load.

Harmonic stiffness variation at the gear mesh results in the need to analyze the forced Mathieu equation. For the range of parameters considered, the dynamic tooth force is found to build up at integral fractions of the natural tooth resonance as well as at the natural frequency. The amplitudes in these regions are limited by the damping in the system. In addition, instability of the tooth force may occur for a particular combination of tooth stiffness variation and damping.

Tooth error results in dynamic force which, unless separation occurs in the teeth, may be analyzed by linear theory. When combined with the possibility of tooth separation and the varying tooth stiffness, the problem becomes highly complex and solution on the analog computer facilitates analysis.

A major portion of the paper is devoted to the analysis of the multi-mass system. Both analog and digital computers are employed in the study where ever they facilitate solution and analysis.

Microfilm \$2.75; Xerox \$8.00. 174 pages.

THERMODYNAMICS AND THE NON-EQUILIBRIUM SYSTEM

(Order No. 61-3104)

Richard Arnold Gaggioli, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Edward F. Obert

It is usual for the engineer to analyze the irreversibilities of real although simple systems in terms of friction and available energy (with rarely a word on entropy production), while the physical scientist analyzes theoretical but complex systems in terms of entropy production (with rarely a word on available energy). Since the entropy production, the loss in available energy and the friction are not numerically equal, the present confusion in the literature can be avoided by developing these irreversibility concepts from a common foundation. In this thesis generalized equations are developed to tie together and to illuminate the subjects of thermodynamic friction, loss of available energy, and entropy production; the equations are applicable to flow or nonflow systems with or without diffusion and with or without chemical reaction, while the body forces may be species- and time-dependent.

Because the study of non-equilibrium systems invariably leads to queries regarding the applicability of the continuum equations of change, the work naturally divides in two parts: microscopic and macroscopic. The microscopic analysis begins with a presentation of the fundamental concepts, which lead to new absolute equations of change. Various continuum characteristics are then defined so that the discontinuous absolute equations can be converted into the more-usual continuum equations of change. In this development the physical significance (on

the micro level) of the continuum concepts of heat and momentum flux evolve naturally, and the domain of applicability of the continuum equations becomes evident.

The principal theme of the macroscopic study is the evaluation of irreversibilities in continuous systems. After introduction of the classical laws of thermodynamics and motion, a new general State Principle is proposed to interrelate the properties of substances. The entropy production and availability concepts are then developed. It is shown that the composition of the dead state must vary for the completely general open system. An available energy balance is proposed to serve as a Second Law complement to the macroscopic mass, momentum and energy balances of Bird. Also presented is an unrestricted "engineering Bernoulli equation."

Various new thermodynamic quantities are introduced and justified: the properties of thermal energy, thermal available energy, and chemical available energy; and a generalized definition of thermodynamic friction. The pertinent equations of change demonstrate quantitatively that loss of available energy arises from the irreversible conversion of chemical and mechanical energies to less-valuable thermal energy, and the irreversible transport of thermal energy to lower temperatures--in other words --from friction. The notions of thermodynamic friction, available energy loss and entropy production are then compared to establish the significance of each.

The analytic equations are applied, along with a defined chemical friction factor, to compressible fluid flow of varying composition, thereby determining the influence coefficients for evaluation of entropy changes. An energy derivation of the Euler equation is presented which corrects an error invariably implied in such analyses.

The topic of available energy has been neglected by the pure scientist in favor of entropy production. But availability accounting is of great value in the cost analysis of engineering systems, since calculation of the actual losses associated with the various processes can be made. These analyses give a rational basis for directing research, development, engineering and labor efforts in attempts to improve operational procedures. Therefore, the macroscopic study is concluded with discussions of steady-flow power plants, of non-steady flow problems, and of piping and insulation problems, to show how the concepts and equations in this thesis can be used in engineering practice.

Microfilm \$4.10; Xerox \$14.40. 317 pages.

FLOW IN AIR-CONDITIONING MIXING CHAMBERS

(Order No. 61-3109)

Charles Morgan Harman, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Delmar W. Nelson

This investigation is concerned with flow in the mixing boxes which are used in double-duct high-velocity air-conditioning systems. Initially, a typical mixing box was set up and operated in a manner similar to the way in which it might be operated in an air-conditioning system. The magnitude of the mean velocity at a number of

measuring stations within the box was measured. This was done using a hot-wire anemometer which was developed particularly for operation in the extremely high intensity turbulence field which is present in the mixing chamber. The design and development of the hot-wire anemometer system was undertaken as a part of this investigation. The degree of mixing of the hot and cold air streams within the mixing box was determined through the use of temperature data. This data was obtained from measurements made with thermocouples. The basic mixing parameter used is the ratio of the point variation from the mean mixture temperature to the mean mixture temperature expressed as a percent and based on the inlet air temperatures.

Measurements inside the mixing box indicated that the ratio of the root mean square of the velocity fluctuations to the mean velocity were very high. This ratio is known as the turbulence intensity. Its indicated value in regions of relatively high mean velocity was on the order of thirty percent, while in regions of very low mean velocity the indicated turbulence intensity increased to values on the order of seventy percent. It was found that the root mean square of the fluctuating velocity was somewhat more uniform than the mean velocity inside the mixing chamber.

The initial mixing box setup was tested under several conditions of operation and was then altered by rearrangement of internal baffles and partitions. It was found that with the initial setup the air velocity in over half of the cross-sectional area of flow was very low and that a large part of the mixing box could be eliminated without appreciable effect on either mixing or flow at the outlet. To the extent of the tests conducted it was found that neither increased flow nor the rearrangement of the baffles and partitions of the mixing chamber had an appreciable effect on the mixing parameter. This parameter averaged approximately thirty-five percent at the sides of the outlet for all tested conditions of operation.

An uncertainty interval of plus or minus five percent is estimated for the mean velocity and mixing results. An uncertainty interval for the root mean square of the velocity fluctuations of plus or minus twenty percent is estimated. All velocity data was processed using a digital computer.

It is believed that the results obtained will be of value and interest to persons associated with the air distribution aspect of air-conditioning since published literature relating to the subject of this investigation does not seem to be available. It is also thought that the technique used and the results obtained can provide the basis for further research in associated air distribution problems.

Microfilm \$2.75; Xerox \$8.60. 188 pages.

LAMINAR HEAT TRANSFER TO A FLAT PLATE IN HYPERSONIC FLOW

(Order No. 61-3264)

John Joyce Kane, Ph.D.
University of Pittsburgh, 1961

The heat transfer to a blunt-nosed flat plate traveling at hypersonic speeds in an oxygen atmosphere is determined. The blunt-nosed plate produces a strong normal

shock which causes the free stream oxygen molecules to dissociate a certain amount depending on the altitude and Mach number. At the outer edge of the boundary layer along the plate, the oxygen molecules and atoms are in thermochemical equilibrium. By diffusion the atoms move through the boundary layer toward the cooled wall, recombining exothermically as the local temperature drops. Either a fully catalytic or totally non-catalytic wall is specified, a fully catalytic wall causing recombination of all atoms which reach its surface, and a non-catalytic wall causing none of the atoms at its surface to recombine.

The velocity distribution is shown to reduce to the problem of Blasius for flow of an incompressible fluid over a flat plate. Solutions are obtained for the enthalpy and atom mass fraction profiles by the substitution of infinite series into the governing energy and diffusion equations. The resultant set of ordinary differential equations are solved for the coefficients of the series. Since the series describe the enthalpy and mass fractions as functions of two variables, variations in the heat transfer along the surface of the plate are determined.

Various conditions of Mach number, altitude, surface temperature, surface catalytic efficiency, and recombination rate constant are studied. It is seen that although the atom mass fraction does not differ appreciably from the limiting case of a frozen boundary layer, the slight difference is sufficient to cause a more significant change in the heat transfer due to the high energy released in the recombination process. In some of the cases, the solutions were limited to relatively small lengths of the plate because of the rapid divergence of the series, which was affected by the boundary conditions of the particular problem studied.

Lewis number effects on heat transfer were studied and a correlation relating the heat transfer to the Lewis number was derived. This correlation facilitates heat transfer calculations by referring them to the relatively simple case of a Lewis number of unity.

Microfilm \$2.75; Xerox \$9.45. 209 pages.

FLEXURE OF A CIRCULAR PLATE WITH A RING OF HOLES

(Order No. 61-3265)

Harry Kraus, Ph.D.
University of Pittsburgh, 1961

The problem of the moment distribution in a finite, circular plate containing a central circular hole surrounded by a ring of k equally spaced circular holes is solved for a uniform pressure load acting over the surface of the plate. The eccentric holes are all of equal diameter but their diameters are not necessarily equal to that of the central hole. A general boundary condition is applied at the rim of the plate in order to make the solution valid for a range of conditions from the simply supported case to the clamped case. The edges of all of the holes are specified to be either free or to have a net shear force acting. In conjunction with these conditions the radial moment at the edges of all of the holes is made to vanish. As a special case of the foregoing the plate without the central hole is solved.

The solution is accomplished within the framework of the Poisson-Kirchoff theory of thin plates by constructing and combining four deflection systems. These relate to (1) the unperforated plate under an arbitrary symmetrical load, (2) the uniform pressure load, (3) the k eccentric holes, and (4) a concentrated force acting at the center of each of the k holes. The latter is required to bring the vertical shear force at the rims of the eccentric holes to zero. These systems are combined by addition and give a deflection function in the form of an infinite trigonometric series whose coefficients are found from an application of the boundary conditions. This results in an infinite set of linear equations whose solution is found by iteration.

To facilitate the rapid calculation of any case, a digital computer program was written with the Fortran Automatic Coding System. The program yields the moment distribution over the critical sections of the plate. Numerical results for a variety of cases involving the subject plate with, as well as without, the central hole are presented. A listing of the program is also given. The results of the computations indicate that as the number of holes, or their size, is increased, the moments in the plate tend to decrease. This behavior is felt to be due to the fact that removal of material by the addition, or enlargement, of the holes also reduces the load on the plate. It was further found that the peak moment in a simply supported plate of the type under consideration is slightly less than twice the peak moment in a simply supported solid plate of the same dimensions.

As a check on the theoretical calculations, the results of two photoelastic tests are presented. The theoretical results are 12-20% above the experimental results; the major reason for this difference being the fact that the epoxy resin test plates had to be made fairly thick to limit their deflection, while the theory is strictly applicable to thin plates only.

Microfilm \$2.75; Xerox \$5.00. 98 pages.

AN INVESTIGATION OF POOL BOILING UNDER INCREASED FLUID BODY FORCE CONDITIONS

(Order No. 61-3283)

Richard Joseph Slember, Ph.D.
University of Pittsburgh, 1961

Supervisor: W. M. Laird

The purpose of this study was to determine the effect of acceleration-produced fluid body forces on nucleate pool boiling from a horizontal cylinder. Rotational motion was used to provide accelerations up to 20 times that of normal gravity. The acceleration vector was normal to the axis of the cylinder, and increased the buoyant forces acting on the vapor bubbles. A range of heat fluxes of from 10^4 (non-boiling) to 5×10^5 Btu/hr-ft² was investigated. In addition to other data, photographs were taken to illustrate nucleate boiling under the conditions of high system acceleration. The photographs indicated that the average bubble diameters at the time of breakoff from the heated surface varied inversely as the acceleration to the $1/2$ power.

A preliminary analysis was performed to provide a basis for a theoretical discussion of the effects of acceleration on a number of characteristics of nucleate pool boiling. Microfilm \$2.75; Xerox \$6.20. 129 pages.

ENGINEERING, METALLURGY

DISLOCATIONS AND SUBSTRUCTURE IN ZINC SINGLE CRYSTALS GROWN FROM THE MELT

(Order No. Mic 61-2027)

Victor V. Damiano, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. Norman Brown

The object of this thesis was to develop reliable techniques for observing dislocations in zinc crystals grown from the melt, to then study the three dimensional configurations of the dislocations and to deduce the mechanisms by which the dislocations interact to form networks and substructures.

The thesis is divided into three phases. In Phase I, a study was made of the range of growth conditions as a function of the cadmium content in zinc over which constitutional supercooling occurred. Under these conditions cadmium segregated in bands parallel to the {0001} plane and the structure was observed at the surface obtained by decanting the liquid away from the solid during the growth of the crystal. Using etching techniques, various sections cut along the growth axis were investigated. Changes in the distribution of etch pits observed by progressive etching were interpreted in terms of dislocation theory. This phase of study yielded information regarding the association of dislocations with segregation boundaries produced by constitutional supercooling. A primary structure composed of arrays of dislocations adjacent to the segregation boundaries arises to accommodate the strain produced by the abrupt compositional gradients. A secondary structure arises when homogenization occurs behind the interface relieving the condition which produced the strain. The dislocations then become arranged into low angle boundaries by the interaction of their stress fields.

In Phase II, dislocations were studied in deformed and annealed crystals. Using a newly devised technique of cinephotomicrography and continuous etching, segments of dislocations decorated with cadmium precipitates were exposed at the surface parallel to the {0001} slip plane. A substructure of the order of ten microns in size developed within the secondary structure after bending and annealing the crystal. Finer hexagonal nets were also observed. Networks and substructures were analyzed in terms of dislocation theory. It was concluded that hexagonal nets arise when dislocations with different Burgers vectors on the {0001} interact. Dislocation walls arise when dislocations with like Burgers vectors interact. Single dislocations and dislocation loops were also observed. Dislocations seen to be associated with inclusions were interpreted as dislocations which were nucleated at

the inclusion. A mechanism for the multiplication of dislocations at inclusions was proposed.

In Phase III, the formation of spiral etch patterns on the {0001} surface of pure zinc crystals was studied. Cinephotomicrographs were taken of the continuous formation of the etch patterns. These were interpreted as the dissolution of a step in the surface at the site where dislocations emerge at the surface. Double ended spirals resulted when the ends of the step were pinned and the step bowed out and circled the pinning points mimicking the Frank-Read mechanism.

Microfilm \$2.75; Xerox \$7.60. 164 pages.

GRAIN REFINEMENT OF COPPER*

(Order No. 61-3303)

George Clifford Gould III, Ph.D.
Case Institute of Technology, 1961

Various methods of developing a commercially satisfactory method for refining the grain size of cast copper were investigated. Additions of metal powders and inter-metallic compounds were made to serve as inoculants; the effectiveness of the peritectic reaction was checked by iron dissolved in molten copper and metals were also added to restrict grain growth by constitutional supercooling or producing an adsorbed layer on the growing crystal. Macrographic examination was employed to determine the effectiveness of the various additions on the grain size and shape. In cases where significant grain refinement was obtained, the mechanical and electrical properties, grain coarsening tendency and recrystallization behavior were determined.

Two elements, lithium and bismuth, selected to produce constitutional supercooling, were very effective in grain refining cast copper. When sufficient iron was dissolved to produce the peritectic, the effectiveness of this reaction was confirmed. A large number of presumed inoculants and additions to restrict grain growth proved inoperative.

*Investigation was sponsored by Office of Ordnance Research, Durham, North Carolina on Contract No. DA-33-019-ORD-2578.

Microfilm \$2.75; Xerox \$3.00. 53 pages.

HYDROGEN EMBRITTLEMENT IN FACE CENTERED CUBIC ALLOYS OF NICKEL

(Order No. 61-3313)

Frank Walter Schaller, Ph.D.
Case Institute of Technology, 1961

The effect of cathodic charging of hydrogen on the ductility of several face centered cubic, nickel alloys was examined.

The results indicate that the introduction of hydrogen in these alloys leads to the formation of a second, face centered cubic phase. The formation of this phase causes the hydrogen to be concentrated near the surface. The surface layer undergoes slow strain-rate hydrogen embrittlement causing a ductility loss in a manner comparable to that of normal brittle skins. The loss in ductility per se or expressed as percentage was not a valid criterion for comparing the degree of embrittlement of the various alloys.

Microfilm \$2.75; Xerox \$3.00. 59 pages.

PRIMARY SOLID SOLUTION PHASE BOUNDARY IN SILVER CORNER OF SILVER-CADMIUM-INDIUM TERNARY SYSTEM

(Order No. 61-3284)

Harold Jack Snyder, Ph.D.
University of Pittsburgh, 1961

The purpose of this investigation was to develop the room temperature and 600°F primary solid solution phase boundaries in the silver corner of the silver-cadmium-indium ternary system.

Alloys for the study were prepared by air induction melting of high purity materials. The resulting ingots were homogenized for 24 hours in dry hydrogen atmosphere at $1040 \pm 10^\circ\text{F}$, followed by furnace cooling. X-ray diffraction, metallography, chemical analyses, electrical resistivity, and dilatometric measurements were used in the course of the investigation. The alloys were first examined at room temperature and then were heat treated in a neutral salt bath operating at a temperature of $600 \pm 10^\circ\text{F}$ for a period of 1 1/2 hours, quenched in water, and re-examined.

Chemical analyses of the alloys were carried out with an accuracy of ± 0.5 weight per cent, and the crystal structure phases present in them were determined with an accuracy estimated to be 1 weight per cent. Microstructures were in agreement with the x-ray diffraction data.

Results show the room temperature and 600°F solid solubility of indium in silver as being greater than 20.3 and less than 21.7 weight per cent. The solid solubility of cadmium in silver at room temperature was found to be greater than 34.9 and less than 41.1 weight per cent. The 600°F solid solubility of cadmium in silver is 43.2 weight per cent. On the basis of these binary solid solubility limits and of the experimental results on the solid solubility of cadmium and indium together in silver, both the room temperature and 600°F primary solid solution phase boundaries in the silver corner of the silver-cadmium-indium ternary system are presented.

Microfilm \$2.75; Xerox \$5.40. 109 pages.

FINE ARTS

THE DOMESTIC ARCHITECTURE OF DETLEF LIENAU, A CONSERVATIVE VICTORIAN.

(Order No. Mic 61-2634)

Ellen W. Kramer, Ph.D.
New York University, 1958

Adviser: Richard Krautheimer

This study of the work of Detlef Lienau (1818-1887), one of New York's forgotten architects, was begun in 1951 at the suggestion of the late Talbot Hamlin; it was carried out under his guidance and that of Henry-Russell Hitchcock, Richard Krautheimer, and Carroll Meeks. Its purpose was threefold: (1) to assess the contributions made by a European trained architect to American architecture at a crucial period in its development--the years immediately preceding and following the Civil War; (2) to stimulate interest in the development of New York architecture between 1850 and 1887, which had been completely neglected up to this time; and (3) to attempt a re-evaluation of Victorian architecture as a whole.

Detlef Lienau, a German-Dane by birth, was one of thousands swept onto these shores in 1848 by the rising tide of revolution in Europe. His arrival here was well timed. The land was opening up, but professionally trained architects were in short supply. Lienau's thorough architectural training in Germany and in the atelier of Henri Labrouste in Paris prepared him well to cope with the multitude of new problems created by shifting populations and an expanding economy in the decades following his arrival here. Lienau's mansarded Shiff house of 1850 on Fifth Avenue--in all likelihood the first example of the Second Empire mode in this country--immediately established his reputation. In the course of nearly forty years of practice, he designed almost every kind of building, from simple cottage to great mansion, as well as commercial structures, churches, schools, libraries, and even a museum. The restriction in scope of this study to Lienau's domestic architecture was deliberate, for this made possible a more detailed analysis of his work both in relation to the general cultural milieu of the time and to the work of his contemporaries. Lienau's houses provide not only the most coherent picture of his own architectural development, but also of the eddying tides of taste and changing patterns of living in the Victorian period. On the stylistic level, the Chalet and the "Stick Style," the Italian Villa and the monumental French Renaissance tradition, reflections of High Victorian Gothic, finally echoes of the "Queen Anne" and the Colonial Revival--all found expression in his work. The eclecticism so apparent here was never capricious, but always adapted to the psychological requirements of the client and to the function and location of the building. From the historical and sociological point of view, Lienau's work mirrors faithfully the fabulous growth of New York City in these decades; his adaptation of the French flat or apartment house system to post-war housing needs of the urban middle class is

merely one aspect of the total picture which a study such as this provides of life a hundred years ago.

Though less well known than Upjohn, Renwick, or Hunt, Lienau was recognized by colleagues and clients alike as one of the most able architects of his time. Among his clients were such prominent figures in the social and economic world of the period as August Belmont, the Schermerhorns, and members of the Astor family. The active role played by Lienau within the American Institute of Architects, of which he was a founder, indicates the high esteem in which he was held by his fellow architects. One more point should be stressed, since it has long been ignored: Lienau, and not Hunt, was the first to bring to the United States a mind and hand shaped, through his association with Labrouste, by the French Beaux-Arts tradition. This background gave to his work a consistently conservative character which is in sharp contrast to the picturesque quality which dominated High Victorian architecture. This left its mark on members of the younger generation, notably Hardembergh and Pelz, both trained in his office. Lienau may be said to have served as a bridge between the classical traditions of the second quarter of the nineteenth century and their re-emergence in the 1880s in the movement led in New York by McKim, Mead and White. Moreover, the clarity in plan, honesty of execution, and restraint in design so characteristic of Lienau's work illustrate eminently well the falsity of the old glib generalizations concerning Victorian architecture.

Lienau enjoyed a large practice, with examples of his work still extant in points as far afield as Germany, Savannah, and Canada. Most of his buildings in the New York area, however, have been demolished. At least a partial reconstruction of his practice was made possible by the existence of the Lienau Collection at Avery Library, Columbia University. Consisting of almost 800 drawings, photographs of his executed work, and original documents, this material was acquired in 1935 by Avery Librarian Talbot Hamlin from J. Henry Lienau, the architect's son. A slim volume containing a brief biography of his father and memorabilia, prepared by Mr. Lienau (1871-1857), was an invaluable source of information.

In addition to the buildings themselves and the material in the Lienau Collection, I have drawn upon greatly diversified sources: contemporary newspapers, illustrated weeklies, popular periodicals, as well as architectural publications both here and abroad. Official records, particularly those of the Building Department of the City of New York, proved of inestimable value. Contemporary guide and travel books, memoirs and diaries, essays and novels all contained much interesting material. The extensive annotated bibliography and biographical notes concerning a number of Lienau's contemporaries should prove helpful to anyone contemplating work in this field. Though the work of scholars such as Bannister, Giedion, Hitchcock, Meeks, Mumford, Pevsner, Scully, and Weisman has added immeasurably to our understanding of Victorian architecture, much work still remains to be done, particularly at the local level.

Microfilm \$5.50; Xerox \$19.35. 429 pages.

THE FRANCISCAN LEGEND
IN ITALIAN PAINTING IN THE
THIRTEENTH CENTURY

(Order No. Mic 61-2662)

William Blackall Miller, Ph.D.
Columbia University, 1961

From the gabled dossal in San Francesco, Pescia, signed and dated 1235, to the twenty-eight frescoes in the upper church of San Francesco in Assisi, the collection of over one hundred and fifty narrative episodes -- in panel paintings, frescoes, miniatures and stained glass -- here present an initial statement and an iconographic development of the Legend of St. Francis of Assisi.

The *Vita I*, by Thomas of Celano, supplied the primary (though not exclusive) source for the earliest illustrations; an iconographic tradition resulting therefrom continued to the last decade of the thirteenth century. A later biography, the *Legenda Maior* by St. Bonaventure, prompted iconographic reinterpretations presented, at the end of the century, in the upper church frescoes. Thus, one may speak of early and later iconographic traditions, and, although the evidence is not direct, there are indications that earlier paintings of Franciscan subjects influenced some revisions found in later texts.

The iconographic developments clarified here for the first time include, among others, the following:

In the early examples of the Stigmatization of St. Francis, one, and later three gold rays stress the spiritual emanation to St. Francis from a heavenly seraph. Later, the fresco in the upper church emphasizes the physical infliction of stigmata on St. Francis. This modification inspired graphic inventions, including a new pose for St. Francis, a rent in his habit, and a clear representation of Christ as the active agent in the apparition.

Evidence from a number of literary references to the stigmatization, including a parchment written by St. Francis and kept by Friar Leo during Leo's lifetime, justifies the identification of the seated friar in the *Stigmatization* in the upper church as Leo.

In the *Sermon to the Birds*, the presence of exotic birds -- peacocks, herons, owls, and others -- resulted from mistranslation of a passage in Celano's *Vita I*. Exotic species first appeared in manuscript illustrations outside of Italy; they occurred in Italian examples only toward the end of the thirteenth century.

An early pictorialization of St. Francis' renunciation of his father and of worldly goods suggests an "abrenunciato," one of the traditional monastic investiture ceremonies.

Although St. Francis is popularly considered to be the inventor of the Christmas *crèche*, and although the paintings have fostered this idea, a careful reading of the texts suggests that his celebration of Christmas at Greccio has only tenuous relationships with the *crèche*.

Franciscan rivalry with the Dominican Order is exemplified in numerous representations and statements. Each Order claimed its founder as the Supporter of the falling Lateran church seen in a dream of Pope Innocent III.

The gabled dossal in the Siena Pinacoteca, heretofore considered a precursor of the program for the frescoes in the upper church in Assisi, is shown to be dependent upon it.

Several historical indications point to Nicholas IV, the first Franciscan pope, as a sponsor for the Franciscan cycle

in the upper church. (There is no attempt here to prove the date and authorship of this cycle.) The selection and treatment of subjects in this cycle present the legend of the Saint conforming to the Conventual views within his Order.

Through the texts and representations discussed in this study, it is shown that the Franciscan legend, in its relatively rapid evolution, and its development toward conformity with the larger *genre* of saints' legends, nevertheless contains a distinctiveness which is dynamic, subjective and humanist in its conception of Christian perfection.

Microfilm \$5.80; Xerox \$20.50. 453 pages.

HENRY O. TANNER--A STUDY OF
THE DEVELOPMENT OF AN
AMERICAN NEGRO ARTIST: 1859-1937.

(Order No. Mic 61-2570)

Walter Augustus Simon, Ph.D.
New York University, 1961

This study is concerned with the evolution of the American Negro painter, Henry O. Tanner, who decided upon a career in art two decades after the Civil War when the social and economic condition of the Negro in American society was at its nadir. An essential position in this paper is that the Negro and the American racial pattern existent in that period are mutually influential; hence the impact of the Negro on America is countered by the impact of America on the Negro.

Chapter I, "American Painting: The Background," presents an approach to American painting and treats of the limited type of portraiture done in a classical style imitative of 18th century European standards. The American hostility to the arts which emerged in the early colonial period is considered along with difficulties encountered in establishing an art school in Philadelphia.

Chapter II, "The American Social Tapestry: Status of the Negro," treats of the negative and complex position occupied by the Negro in America and of his adjustments to existence within this framework.

Chapter III, "Family Background: The Matter of Human Bondage," deals with the personality of Tanner's father, Benjamin Tucker Tanner, a third generation Pittsburgher, a college educated minister, teacher and author. Also considered is the effect on the Negro populace of Darwin's *The Origin of Species* and deGobineau's *L'Essay sur l'inegalite des races humaines* and how these writings were utilized in a general condemnation of the Negro in the North and South.

Chapter IV, "The Early Years in Philadelphia," traces the movement of the Tanner family from Pittsburgh to Philadelphia where Tanner, aged twelve, discovered painting and initially encountered the ridicule and abuse he was to be familiar with as a Negro in the arts.

Chapter V, "Study at the Pennsylvania Academy With Thomas Eakins," establishes Tanner's fundamental training in the naturalistic tradition in painting with its emphasis, under Eakins, on the nude figure. Also considered is the matter of Tanner's fair-complexion which, had he so chosen, would have permitted him to "pass." The

decision to combine business and art and to recoup his health in Georgia is introduced.

Chapter VI, "Factors Leading to Expatriation," deals with Tanner's experiences in the South and treats of the vicious "Jim Crow" system. The Freudian concept that recourse to the arts is a compensatory activity for persons seeking escape from harsh reality is introduced. Tanner's two benefactors, the Hartzells, assist him in his Atlantan venture and also arrange his leaving America to study abroad.

Chapter VII, "The Years in France," presents Tanner in Paris, still shy, sickly and poor, studying at the Academy Julian under Constant and Laurens. The evolution of the Academy Julian is treated along with a discussion of the position of the French Academy and the Beaux-Arts tradition. Tanner contracts typhoid fever and returns home.

Chapter VIII, "Recognition," is concerned with Tanner's successes after a lifetime of failure. His mature style now emerges which embraces a treating of Biblical scenes and events. A *Daniel in the Lions Den* receives an honorable mention in the *Salon* and *The Resurrection of Lazarus* is purchased by the French Government. Two trips to the Holy Land furnish material for innumerable Biblical canvases. At forty, he marries and has a son. Later he is honored by France by election to the Legion of Honor. France becomes his home, for here he is honored for his creations and is not debased and humiliated because of his race. Microfilm \$2.75; Xerox \$9.70. 211 pages.

SAN CARLO ALLE QUATTRO FONTANE,
A STUDY IN MULTIPLE FORM AND
ARCHITECTURAL SYMBOLISM.
(VOLUME ONE: TEXT.
VOLUME TWO: ILLUSTRATIONS).

(Order No. Mic 60-5296)

Leo Steinberg, Ph.D.
New York University, 1960

Adviser: Professor Wolfgang Lotz

A brief preface enumerates the documents, sources and essential literature bearing on the church of S. Carlo in Rome. It also itemizes the alterations undergone by the building since the death of the architect, Borromini, in 1667.

This is followed by an introduction in which the problem is posed: that the mere plan of the church has been interpreted by previous students in no less than twelve different ways. These twelve approaches to defining the "primary form" of the church are presented and discussed in Chapter I, at the conclusion of which it is suggested that S. Carlo's plan can only be understood as a contrapuntal design, in which three forms -- an octagon, a cross and an oval -- coexist in perfect simultaneity.

Chapter II discusses the evidence of Borromini's own drawings. Three drawings published in 1924 as early phases of the design are shown to be neither by Borromini, nor for this church. An alternative series of drawings from the Albertina in Vienna, mostly unpublished, are presented, and their analysis proves compatible with the triform hypothesis.

Chapter III -- The Formal Hypothesis -- discusses in turn each of the three forms which coexist in the design. The church plan is shown to be a restatement of the theme of the octagonal Cloister, enriched by four chapels. It is also shown that the diagonal wall sections are treated as the piers of an octagonal crossing. This, and additional evidence, put it beyond doubt that the octagon is materially present in S. Carlo and indispensable to its interpretation. The argument proceeds to show that the cross is equally present; though it is merely adumbrated in plan, it is clearly emphasized by the illusionistic devices which, in elevation, create the impression of four extended cross arms. Finally, it is shown that the elusive curvature of the chapel plans can be understood only on the assumption of a perimetric oval which intermittently circumscribes that of the dome. Thus all three forms appear to be materially present in the design of the church, and each of them proves essential to its full interpretation.

Chapter IV shows that the columnar articulation of the interior is designed in three distinct but overlapping cross rhythms. It is found that each of them corresponds to one modality of the whole structure; each of the three forms constituent of the church, has, as it were, its own system of columnar supports. As the columnar articulation confirms the triform hypothesis, so does the wall treatment. The two-way tension felt in the diagonals results from the necessity to suggest at once the octagon and the oval; just as the illusionism employed in the axes is used to satisfy the dual demand to express simultaneously the oval and cross.

Chapter V treats of the dome. Its complex coffering pattern is shown to be an ideal restatement of the forms of the plan. Finally, the same three forms are found in clear, simple progression within the lantern. The same three forms which conjoin in the lowermost zone in appalling complexity, and which the dome pattern repeated in tightening juxtaposition, reappear in the lantern in resolution to form a stately emanation from the heart and summit of the total design. The conclusion of the chapter produces evidence that the combination of cross, oval and octagon was consciously entertained in the architect's mind: the conjunction of the three forms turns up in numerous variations -- in the garden layout, the plan of a fountain, a crypt chapel, in tracery windows and emblematic ornaments. It becomes clear that the cross-oval-octagon theme was relentlessly present in Borromini's mind during his work on S. Carlo.

In Chapter VI -- the "Iconographic Hypothesis" -- the question is raised whether this feat of contrapuntal design was pursued solely as an aesthetic adventure, or whether the artist was led to his attempt, and sustained in it, by symbolic considerations. It is proposed that the church -- one substance manifesting itself under three forms -- is conceived as a vast emblem of the Trinity.

The suggestion receives a preliminary plausibility from the fact that the church was built for the Spanish Order of the Trinitarians. More significant is the long-forgotten fact that its primary dedication was to the *SS. Trinità*. This is attested by inscriptions, by the documents, and by numerous emblems within and without the church, many of them -- such as the triangle in the lantern -- designed by Borromini himself. Further analysis of the building shows that its articulation is triadic throughout, even to a projected triangular campanile. It seems inconceivable that an architect who allowed the ternary number to control

so much of his architectural thought -- and this in a church built for Trinitarians, dedicated to the Trinity and crowned by the Trinity's emblem -- should have remained unaware of the symbolic potential of his own scheme.

The chapter proceeds to discuss architectural precedents for Trinity symbolism, the general period tendency towards symbolization, and the place of the Trinity dogma itself in contemporaneous theology; the purpose being to demonstrate that the "iconographic hypothesis" here proposed is thoroughly compatible with the mood of the time.

Chapter VII -- "The Artist" -- attempts to show that the hypothesis is equally compatible with Borromini's personal style, which reveals itself as pervaded by forms of multiple function and latent symbolic intent. Among the architect's works briefly studied is S. Ivo, for which a new interpretation as the House built by Holy Wisdom is proposed. The chapter closes with a critique of previous attempts to expound the architect's personal psychology.

Chapter VIII -- "Last Speculations" -- raises the question whether, in addition to the three-in-one symbolism, each of the three forms composing the church may not

have its peculiar symbolic function. Thus it is shown that the internal octagon at S. Carlo is a similitude of the crossing area of St. Peter's. It is suggested, though not proven, that S. Carlo, insofar as it reproduces the basilica, symbolizes the Church as the See of St. Peter. This leaves the cross and the oval; and they are shown -- with probability rather than certainty -- to symbolize the World pervaded by the rule of Christ.

In a final hypothesis these same forms of oval and cross are further interpreted as the Body of Christ, adapting the Eucharistic emblem to the plan of the church.

What is implied in the entire argument of the dissertation is that Borromini, being asked to build his first church, had asked himself -- what is a church; what does it stand for? His answer -- if these hypotheses are at all credible -- is that the church building is a microcosm of the Church Universal; therefore it stands for the See of St. Peter and the mystic Body of Christ, for the world's circuit suffused by the cross, and -- in the singleness of its substance and its manifold forms -- for the nature of God.

Microfilm \$5.15; Xerox \$18.25. 404 pages.

GEOLOGY

STATISTICAL ANALYSIS OF FOLDS.

[Geological and structural maps of Amisk Lake area not microfilmed. These are available for consultation at the Princeton University Library, Princeton, New Jersey].

(Order No. Mic 61-484)

Clinton Dennis Augustine Dahlstrom, Ph.D.
Princeton University, 1953

Poles to cylindrically folded bedding or gneissosity fall on a great circle where plotted on a stereo net. The axial line is perpendicular to this great circle. This provides a simple and accurate method of determining fold attitudes. Statistical application of this principle permits determination of limb and axial plane attitudes, crestal curvature, inter-limb angle and of the type of foliation and lineation present. The method is illustrated by examples drawn from the literature and from the Amisk Lake area.

Microfilm \$2.75; Xerox \$4.60. 86 pages.

DISTRIBUTION OF FORAMINIFERA IN THE NORTHEAST PACIFIC

(Order No. Mic 61-1317)

Betty Joyce Enbysk, Ph.D.
University of Washington, 1960

Chairman: V. S. Mallory

The distribution of Foraminifera in Northeast Pacific surface sediments was compiled from an examination of

103 shelf and slope samples and 47 deep-sea samples. Associated biogenic elements and sediment types were recorded and ecologic factors affecting the distributions evaluated.

Bathymetric position is the most important limit on the number of individuals and species and specific occurrences. Significant bathymetric ranges presented are in general agreement with other West Coast studies. Temperature is a factor in the neritic and upper bathyal ranges as faunas tend to rise in bathymetric position to the north. This trend is not without irregularity however. Particle size of enclosing sediment is less important except to the few species limited to a specific substrate. Poor sorting is associated with higher foraminiferal numbers. Sediment supply and stability are very important factors and the vagaries of distribution may be due to complex topographic and sedimentation conditions. Winnowing and downslope displacements are important on topographic highs of the slope and deep-sea area.

Four deep-sea bio-lithologic areas defined by Nayudu (1958) are described in terms of their Foraminifera content. (1) The Globigerina-rich area, a narrow band paralleling the Oregon-Washington coasts 300 miles offshore, has the greatest diversity of species and highest numbers of individuals of both planktonic and benthonic forms. (2) The Radiolaria-rich area is practically barren of Foraminifera. (3) The diatom-rich area of the Gulf of Alaska coincides with the Alaskan Gyral and contains many arenaceous species. (4) The Seamount area is characterized by very great numbers of individuals and species. The course and history of the water masses involved seem more important than specific ecologic factors.

Specific occurrences within the study area are listed with brief faunal references.

Microfilm \$3.15; Xerox \$11.05. 244 pages.

PLANT MICROFOSSILS OF THE
LAMINATED SEDIMENTS OF
THE LOWER EOCENE WILCOX GROUP
IN SOUTH-CENTRAL ARKANSAS

(Order No. 61-2938)

Eugene Laverne Jones, Ph.D.
The University of Oklahoma, 1961

Major Professor: Dr. L. R. Wilson

A total of 62 spore and pollen genera are described from the laminated sediments of the Wilcox group in south-central Arkansas. Of these, 40 are assigned to natural plant genera and the remainder to form genera. Angiospermous pollen dominates the microflora, and a small, tricolporate type, identified as *Castanea*, is the most abundant. The spores *Anemia* and *Lygodium* are common. The gymnosperms are represented by *Pinus*, *Taxodium*, *Cryptomeria*, *Podocarpus* and *Ephedra* (?).

The microflora and the megafloora of the Wilcox group have few genera in common. The same situation has been described for other well-known fossil floras. The Wilcox microflora like the megafloora is a mixture of temperate and tropical plant genera. An area like that of present day eastern Mexico, with highlands adjacent to a warm, low coastal plain, is postulated as the lower Eocene environment of the Gulf Coastal Plain. The absence of detrital feldspar in the Wilcox sands, despite the presence of a local igneous source, supports this interpretation. The deltaic origin of the Wilcox group in Arkansas, indicated by sedimentary features, is also suggested by the presence of small numbers of Dinoflagellata and Hystrichosphaeridae throughout the section.

The microflora is relatively uniform in composition through much of the section. This is expectable because the nature of the sediments indicates little or no change in the environmental conditions. A distinctive change, an abrupt decrease in tricolporate pollen, does occur in the upper part of the section and possibly is of regional stratigraphic significance. Two other floristic anomalies, an increase in *Pinus* pollen and an increase in dinoflagellates, are also possibly stratigraphically important for regional correlation. A comparison of the Wilcox microflora with other Tertiary spore and pollen floras reveals a close similarity with the Eocene microfloras of Europe.

Microfilm \$2.75; Xerox \$6.40. 135 pages.

PETROGRAPHY OF THE SANFORD HILL
TITANIFEROUS MAGNETITE DEPOSIT,
ESSEX COUNTY, NEW YORK.

(Order No. Mic 61-1905)

Marvin Allan Kays, Ph.D.
Washington University, 1961

Chairman: Wilford F. Weeks

The geology of the Sanford Hill titaniferous magnetite deposit, Essex County, New York, is of considerable interest both for genetic and economic reasons. Although this deposit has been studied intermittently since 1842,

recent open pit mining operations and an extensive diamond drilling program have now made possible a detailed mineralogical study of the deposit.

Field studies indicate that the whole region now occupied by the Sanford Hill ore body was originally anorthosite with a plagioclase composition of An_{64} . No evidence has been found in the Lake Sanford area to indicate whether this anorthosite was originally formed by a magmatic or a metamorphic process. Field evidence however, strongly indicates that the anorthosite was solid previous to the introduction of ore minerals. Both the rocks and the ore units of the deposit show definite metamorphic characteristics. Granulation and a general decrease in grain size with an increased gneissic or banded structure occurs in the gradational rock sequence anorthosite \rightarrow gabbroic anorthosite \rightarrow gabbro. All evidence indicates that the occurrence of all the gabbroic units is structurally controlled by shearing and its resultant granulation. Definite degrees of structural deformation are found to correlate with certain mineral associations developed in the transition of anorthosite to gabbro. Each of these changes is dependent upon the transition of the initial labradorite to a more sodic plagioclase with the resulting release of Ca and Al. A study of the major cation distribution from a large number of modal analyses indicates that the amount of Ca and Al released during "andesinization" of the labradorite closely correlates with the amount of Ca and Al in the mafic minerals now present in the rock. This process is also very important in controlling the nature of the ore minerals. In the gabbroic rocks where the granulation caused extensive release of Ca and Al, the formation of mafic minerals has fixed a large portion of the iron in the introduced ore forming phase. Therefore the resulting gabbroic ore has an ilmenite/magnetite ratio of greater than one. In the anorthositic ore, however, the ilmenite/magnetite ratio is less than one since mafic silicates are present in only minor quantities.

X-ray studies of the ore reveal two magnetic phases. The predominant phase has a lattice parameter of 8.40 Å indicating a magnetite with a minor amount of Ti in solid solution. The minor magnetic phase occurs as sub-microscopic intergrowths in the magnetite and has a lattice parameter of 8.43 Å. This measurement indicates that the minor magnetic phase is a mixed crystal of the series, $Fe_3O_4 - Fe_2TiO_4$. The magnetite with a lattice parameter of 8.43 Å contains approximately 33 molecular percent Fe_2TiO_4 . Lattice parameter studies of ilmenite indicate a unit cell comparable to pure $FeTiO_3$. Ore mineral relations indicate relative temperatures of formation in the range of 400° to 500°C.

Microfilm \$2.75; Xerox \$7.80. 166 pages.

LATE CENOZOIC GEOLOGY OF THE
LOWER SAFFORD BASIN ON THE
SAN CARLOS INDIAN RESERVATION, ARIZONA.

(Order No. 61-2993)

James Irvin Marlowe, Ph.D.
University of Arizona, 1961

Supervisor: John W. Harshbarger

Terrestrial sediments of late Cenozoic age occur in the bedrock trough of the lower Safford Valley to an unknown depth. These sediments are largely fluvio-lacustrine in origin and have been deposited by the ancestral Gila River, its tributaries, and bodies of water isolated from the main drainage. They are composed of silt, sand, and clay for the most part, but locally limestone comprises the predominant nonvolcanic lithology. A thick series of limestones and pyroclastic sediments is preserved beneath lava flows at the northwest end of the valley. Elsewhere, erosion has removed beds equivalent to these limestones and tuffs and only a lower part of the sedimentary section is preserved. Volcanic vents and breccias are closely associated with the thick limestone accumulation.

The age of the basin fill is considered to be Upper Pliocene to late Kansan. Lower beds are equivalent to those near Safford, Arizona, which have been dated on fossil evidence as Kansan. The upper part of the section is probably considerably younger than the Safford beds.

Deposition of the basin fill took place on a wide fluvial plain of low gradient, in an environment somewhat more moist than prevails today. Sluggish drainage allowed the formation of ponds and lakes of varying duration. Stream-flow from the adjacent mountains locally deposited gravel in alluvial fans which interfinger with the fine-grained basin fill. Volcanic activity at the west end of the valley caused disruption of drainage by ash falls and lava flows, allowing the accumulation of chemical limestone in isolated basins. Due to aggradation and damming by lava flows, the Gila River reoccupied its ancient channel through the Mescal Mountains and proceeded to cut its present gorge, ending deposition in the basin and initiating erosion. Subsequent climatic change caused bevelling of the basin-fill beds by erosion surfaces, an older one of which is now preserved beneath lava flows.

Microfilm \$3.20; Xerox \$11.25. 247 pages.

THE GEOLOGY OF THE
KINGFIELD QUADRANGLE, MAINE.

(Order No. Mic 61-2418)

Stanley Alfred Skapinsky, Ph.D.
Boston University Graduate School, 1961

Major Professor: Caleb Wroe Wolfe

The Kingfield quadrangle is located in north central Maine. Work has been completed in adjacent quadrangles on the east, west, and south. Study of the petrology, stratigraphy, structure, and geomorphology reveals the geologic history of the area.

The topography, a result of modifications by Pleistocene glaciation imposed on a landscape of late maturity, has been developed on the following formations (from oldest to youngest): Lost Brook, Perry Mountain, Parmachenee, and Madrid. More than 12,000 feet of Ordovician to Mid-Silurian strata constitute a variety of rock types which have undergone the effects of regional and contact metamorphism.

Gray non-bedded phyllites and schists with chlorite, staurolite, and pseudomorphic andalusite comprise the Lost Brook Formation. Rhythmites of thin-bedded gray schists and arenaceous quartzites containing chlorite, biotite, sericite, and andalusite form the Perry Mountain Formation. The Parmachenee Formation contains interbeds of black slaty schist, black limestone, and gray quartzite, all with pyrite and pyrrhotite. Much of the quadrangle is underlain by the Madrid Formation which consists of massive calcareous quartzites and phyllites interlayered with thin schists. Minor amounts of pyrite and siderite are restricted to the quartzites and phyllites. Lower horizons consist of gray arenaceous thin interbeds of two-mica schists and biotitic quartzites. Dark gray slates with thin quartzites form the Dyer Hill Member of the upper part of the Madrid Formation. This formation correlates lithologically to rocks in adjacent quadrangles containing Mid-Silurian fossils.

Irregular compositional variations within a cooling pluton produced differentiates--quartz monzonite and granodiorite. Quartz diorite and diorite of the plutonic border zone resulted from reaction and assimilation of country rock. During late stages of the Acadian orogeny which began in post-Early Devonian the pluton forcefully invaded the pre-existing rocks. Radioactive dating of similar intrusive bodies near Kingfield gives an average age of 385 million years. The margin of a uraltized gabbroic body extends into the quadrangle west of Tufts Pond.

Regional metamorphism developed minerals which are typical of low- and middle-grade zones. Contact metamorphic zones associated with the pluton have been superimposed on the regional metamorphic zones. Regional metamorphic intensity increases northwestward. Zones of contact metamorphism follow plutonic contacts. Metamorphism has reconstituted the carbonate minerals as calc-silicates.

Siderite, calcite, and pyrite developed under varying oxidation potentials and pH conditions in the original sedimentary environments. Whether pyrrhotite and (or) pyrite formed during metamorphism depended on the initial bulk composition of syngenetic sulfides. Some pyrrhotite developed as an authigenic mineral under favorable Eh-pH conditions. Euxinic conditions prevailed in barred basins in which sulfide-bearing sediments accumulated.

Bedding and foliation are essentially parallel in attitude, trending northeastward and always steeply dipping. The axes of major folds trend northeastward. Axial planes of minor folds are overturned and dip to the northwest. Noses of plunging major folds are not found. The limbs of tight major folds apparently do not converge presumably because the angles between the limbs are so small that the beds appear to be parallel in widely spaced outcrops. No major faulting is evident.

During the geologic interval from the Acadian orogeny to the Pleistocene the area was subjected to erosion and intermittent uplifts. Pleistocene ice sheets covered the area, scraping material from the higher elevations and

spreading it over lower areas as till. Meltwater from the last stagnating ice sheet reworked some till and deposited kames, eskers, kame terraces, lake sediments, and outwash plains. The Kennebec estuary may have extended to the quadrangle.

Post-glacial history is characterized by uplift with continued erosion as streams have partially eroded glacial deposits and formed alluvial terraces.

Microfilm \$3.80; Xerox \$13.50. 296 pages.

THE GEOLOGY OF THE ISLAND OF MARGARITA, VENEZUELA.

(Order No. Mic 60-5063)

Gordon Cosmos Taylor, Ph.D.
Princeton University, 1960

The northern part of the island of Margarita is underlain by an igneous and metamorphic complex. A conformable sequence of metavolcanic and metasedimentary rocks named the Juan Griego group are the oldest rocks exposed. The Juan Griego group is made up of two divisions, a lower one, the Tacarigua amphibolite, and an upper one, not formally named, which consists of schists and gneisses in which garnet is common. They have been highly deformed. Several varieties of ultramafic rocks, metadiorite, and soda granite have intruded the Juan Griego group. The Los Robles group borders the Juan Griego group on the south and east. This complex is a thick sequence of phyllites and phyllitic-schists. Near the base of these phyllites there is 200 m of marble. The marble has been named the El Piache marble member. The Los Robles group is interpreted to be unconformably above the Juan Griego group and to be probably late Cretaceous.

The southern part of the island is underlain by unmetamorphosed rocks, mainly Tertiary. The oldest of these rocks is of volcanic origin belonging to the Los Frailes

formation. Only a small remnant of this formation now remains, but it supplied much of the detritus for later deposits. It may be late Cretaceous.

The oldest dated rock is the Los Bagres limestone. This is dense, dark gray, finely crystalline and contains scattered pebbles of the Los Frailes volcanic rocks, poorly preserved corals, and a foraminiferal assemblage dated Paleocene or early Eocene. Only small remnants of this formation are now preserved.

Unconformably overlying the Los Bagres limestone is the middle and upper Eocene Punta Carnero formation. These orbitoid-bearing thin limestones, conglomerates and shales are about 2000 m thick. They are folded into a broad syncline, the north flank of which is locally overturned.

A thin sequence of mudstones and claystones of bright yellow to buff color unconformably overlie the Punta Carnero formation. These rocks have been named the La Guica formation. A few leaves and casts of mollusks are present but these are too poorly preserved to give a specific age.

Middle Miocene beds of the Cubagua formation unconformably overlie the La Guica formation. For the most part these are either semiconsolidated or unconsolidated marls, sandy marls, shell beds, or locally consolidated porous limestones.

On the southwest portion of the island unconsolidated late Tertiary sediments are exposed but have not been subdivided. They are known to include some beds of the Cubagua and possibly younger formations.

An unconsolidated deposit of fine-grained hematitic stained quartz sands blankets most of the eastern part of the island that lies below 70 m in elevation. These sands have been designated as the Falca formation. They have been dated as probably late Pliocene or early Pleistocene.

Marls and impure limestones of Pleistocene age are exposed in a terrace on the coast near Juan Griego. Gravels capping low hills on the southern desert are also probably of Pleistocene age.

Microfilm \$2.75; Xerox \$6.80. 144 pages.

HEALTH SCIENCES

HEALTH SCIENCES, PHARMACY

A PHARMACEUTICAL STUDY OF ALUMINUM CARBOXYMETHYLCELLULOSE JELLY

(Order No. 61-3273)

James Cyrenius Newcomb, Ph.D.
University of Pittsburgh, 1961

Pharmaceutical jellies made with synthetic gums have obvious advantages over those made with naturally occurring gums, particularly in reproducibility, uniformity, and availability. Sodium carboxymethylcellulose is an example of a synthetic gum which is widely used as a thickening agent in jellies.

Previous work has indicated that aluminum ions are

capable of causing the gelation of dilute sodium carboxymethylcellulose solutions. It was the purpose of this research to devise a suitable method for the preparation of a pharmaceutically acceptable aluminum carboxymethylcellulose jelly, and to investigate certain of its physical and pharmaceutical properties.

The method which was developed involved the addition of dilute potassium alum solution to acidified sodium carboxymethylcellulose solution, at lowered temperature and with adequate agitation. Clear jellies could be produced only when the pH of the sodium carboxymethylcellulose solution was adjusted to near five with sulfuric acid, prior to the addition of alum solution, and when all the reactants had been cooled to 5°C.

It was postulated that the combination of lower pH and lower temperature suppressed the ion-carboxyl group

linkage until that linkage could develop instantly and totally, thereby lessening the possibility of precipitation of insoluble aluminum carboxymethylcellulose.

It was found that better jellies could be prepared from potassium alum than from aluminum sulfate, chloride, or acetate.

Two formulations were suggested, differing only in aluminum ion concentration and in final consistency.

Presumably due to structural nature, the jellies exhibited a tendency to "slippage," rather than true flow. This tendency presented difficulties in the measurement and description of the systems' consistencies in terms applicable to related systems.

The jellies were clear, firm, and consistency-stable to temperatures from five to seventy degrees Centigrade. When evaporated, they were capable of forming films; they appeared to be somewhat water-repellent; and they did not adhere readily to glass or metal surfaces. The gel structure was altered and/or broken by strong acids or bases, and by chelating agents such as EDTA and sodium citrate. Further, they were completely miscible with glycerol and with propylene glycol. Consequently, it was suggested that many pharmaceutical modifications of the jellies might be possible.

Microfilm \$2.75; Xerox \$3.80. 67 pages.

HEALTH SCIENCES, PUBLIC HEALTH

A STATISTICAL APPROACH TO THE DYNAMICS OF PATIENT SURVIVAL

(Order No. 61-3295)

Sidney J. Cutler, Sc.D. Hyg.
University of Pittsburgh, 1961

A method has been presented for analyzing the survival experience of patient cohorts that indicates whether after some time mortality has decreased to a normal level. This involves the comparison of survival rates, in successive intervals of observation, with the corresponding rates in a control population which is similar to the patient group except for the absence of the disease under study. In practice, the survival experience of the general population, as reflected in life tables for the United States and individual states, may be used to represent the survival of a hypothetical control population.

The relationship between the observed survival rate in each interval of observation and the rate expected on the basis of general population experience is expressed as a ratio. The trend of such interval survival ratios reflects the changes over time in the relationship between two forces of mortality: (1) associated with the specific disease under study, and (2) due to all other possible causes of death. It is assumed that these two forces act independently and simultaneously, but the method requires no assumptions concerning the form of the distributions of deaths.

The method of interval survival ratios can provide insight into the impact of the disease process on survival in the absence of specific information on causes of death. This is particularly valuable in view of the fact that accurate and complete information on cause of death is frequently not available in instances in which accurate information on survival time is available. Furthermore, although a death may be properly classified as due to a disease other than the one under study, the so-called "other cause" may itself be a manifestation of the specified disease. It is therefore useful to think in terms of mortality risk associated with the disease under study rather than due to the specified disease. Cancer data were used to illustrate four patterns in the trend of the mortality risk associated with the specified disease (specific mortality risk):

- (1) The specific mortality risk persisted over the entire period of observation (15 to 20 years);
- (2) The specific mortality risk decreased to zero, or close to it, and then increased again;
- (3) The specific mortality risk decreased to zero and did not reappear;
- (4) The specific mortality risk decreased to zero and the total mortality risk decreased to a below-normal level.

It is suggested that the identification of such patterns provides a useful approach to the evaluation of therapeutic results and may provide insight into the impact of the disease process and the nature of the patient group. For example, the second pattern suggests that therapy may serve to delay the disease process, but that this delay is followed by a breakdown of biological defenses. The fourth pattern suggests the presence of a sub-group of patients (the long-term survivors) that in some way is less susceptible to "normal mortality risk" than members of the general population. Other interpretations are of course possible. Microfilm \$2.75; Xerox \$6.40. 131 pages.

HISTORY

HISTORY, GENERAL

PROTESTANT CHURCHES AND THE NEGRO: A STUDY OF SEVERAL MAJOR PROTESTANT DENOMINATIONS AND THE NEGRO FROM WORLD WAR ONE TO 1954.

(Order No. 61-2975)

David Morgan Reimers, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Merle Curti

This study deals with the relations of several major Protestant denominations and the Negro in the period from World War One to 1954. The denominations studied are the Congregational Christian Church; the Methodist Episcopal Church; the Methodist Episcopal Church, South; the Presbyterian Church in the United States, the southern Presbyterian church; the Presbyterian Church in the United States of America, the northern Presbyterian church; and the Protestant Episcopal Church. In 1940 the Methodist Episcopal Church and the Methodist Episcopal Church, South, merged to become the Methodist Church.

Some consideration is given to the churches' attitudes toward the race problem in secular life; but on the whole the emphasis is on internal aspects of the churches, such as congregations, national and regional conferences, and administration, where the churches can actually influence and control policy. Only one church-related institution, the theological seminary, is considered, because the denominations still maintain a considerable degree of control over their seminaries.

At the time of the first world war, the approach of these denominations toward the race problem was directed at domestic missionary work and Christian education in schools for Negroes. On the whole little heed was paid to the social problems of Negroes and segregation. In the churches themselves segregation was the mode for accommodating Negro members.

During the 1920's and 1930's some interest was paid to the race problem, and individual churchmen and especially church women were active in the interracial movement. Little change took place, however, in the actual racial practices of the churches; and a serious reappraisal of the relation of segregation and discrimination to Christian concepts did not come until World War Two when Americans began to reassess the race problem.

Beginning in the 1940's the churches became increasingly critical of their own practices regarding the Negro. Northern churchmen, like northerners in general, were more liberal than southern churchmen. The Protestant groups under study criticized segregation and discrimination and called for a truly interracial Christian church. Segregation was eliminated in various aspects of church life and a movement began to foster interracial congregations. On the whole, however, at the time of the Supreme Court's decision on public school segregation the practices

of these denominations lagged a good deal behind their liberal pronouncements. Differences between denominations seemed to be mainly differences in regional customs, social status, and individuals as no one denomination was clearly more progressive than the others. The southern Presbyterian church did lag behind the other denominations. Moreover, the churches reflected shifts in American attitudes at large.

Microfilm \$4.45; Xerox \$15.75. 346 pages.

HISTORY, MODERN

TRENDS IN RECENT EUROPEAN THOUGHT ON AMERICA

(Order No. 61-3256)

Edward William Chester, Ph.D.
University of Pittsburgh, 1961

This study represents the first substantial examination of the ideas of the leading thinkers of Europe since World War I on the United States. The major figures stressed in this monograph are Arnold Toynbee, Harold Laski, Denis Brogan, Andre Siegfried, Bernard Faÿ, Hermann von Keyserling, and M. J. Bonn, but over fifty others are given at least incidental mention. The primary emphasis is placed on books, although articles are also analyzed. Most of the material treated here was written in English or has been translated into that language, but a number of books and articles in the original French and German are also cited.

The first chapter discusses both the American attitude towards space and time and the sectional structuring of this country. In contrast, the second examines various aspects of immigration and racism, citing the Negroes as a typical minority group. The third chapter is of particular interest, as it investigates the American character in detail, stressing both its strengths and its weaknesses. Chapter four emphasizes politics and democracy, while chapter five views the functioning of national, state and local government under the Constitution.

American capitalism is dealt with in the sixth chapter, which closes with an analysis of American labor. This chapter is complemented by chapter seven, which treats the failure of radicalism here, but also examines the paradoxical fact that this nation and the Soviet Union have many things in common. On the other hand, chapter eight explores the complexities of the New Deal, but refrains from making an over-all evaluation of the Rooseveltian reforms. The ninth and tenth chapters stress foreign policy, as the ninth analyzes the role of imperialism and isolationism in United States history, while the tenth traces the assumption by this country of a role of world leadership.

An examination of the fields of theology and philosophy takes up the eleventh and twelfth chapters, which usher in the final third of this study. Number eleven discusses the controversial question of whether or not the United States is a truly religious nation, while number twelve evaluates the importance of pragmatism and materialism in American life. In contrast, the thirteenth chapter analyzes the cultural tradition and educational system of this country. Chapter fourteen, which is the longest, treats American contacts with England and France, as well as investigates the critical question of whether the United States and Europe are essentially similar or different. The final chapter compares American and European ideas about this nation, and closes with an evaluation of European thought on America, both as a whole and vis-à-vis various writers.

Perhaps the most important point which this monograph makes is that Europeans do not believe Americans to be as materialistic as Americans think they do. Other significant insights are also offered, such as that the majority of Europeans believe that their way of life is qualitative and ours quantitative, and that most of them feel that the Old World emphasizes the temporal factor and the New the spatial one. Although European analysts at times offer questionable interpretations of American life, it is quite noteworthy that they generally present the facts accurately. American commentators, on the other hand, often give a distorted picture of European ideas about the United States, and this adds to the misunderstandings which arise now and then between Europe and America.

The bibliography to this work represents the first really comprehensive listing of books and articles on the subject. Microfilm \$4.25; Xerox \$15.10. 331 pages.

AGLIPAYANISM AS A POLITICAL MOVEMENT

(Order No. Mic 61-745)

Sister Mary Dorita Clifford, B.V.M., Ph.D.
St. Louis University, 1960

The Spanish-American War of 1898 was hardly a major landmark in military history and yet it had far-reaching results in many areas of international relations. The Treaty of Paris dissolved the last bond connecting Spain with the remnants of her once great colonial empire. It raised the United States of America to the status of a world power and saddled her with colonial responsibilities in the Caribbean and in the Pacific which were without precedent in American history. It upset the balance of power in the Pacific and gave the United States a greater stake in the future development of the Far East.

American occupation of the Philippines in August, 1898, created a domestic crisis in the United States which threatened, for a time, to split the two major political parties. It created an even greater domestic crisis in the Philippines where ardent nationalists were reluctant to exchange Spanish domination for the political tutelage offered by the United States. The result was the Filipino insurrection 1899-1901 which cost the United States far more in money and men than the Spanish-American War had cost. American military might crushed the insurrection and forced the militant Filipino nationalism to go underground. This

underground movement, under the guise of a schismatic church, carried on the fight for independence from 1902 until the end of American occupation in 1946.

The schismatic church, *Iglesia Filipina Independiente*, was a ready-made disguise because the pattern of Filipino nationalism from 1872 until the outbreak of the war had been typically Spanish in its anticlericalism and pro-Masonic affiliations. The founder of this movement, Isabelo de los Reyes (1864-1938), found an ally in an excommunicated priest, Gregorio Aglipay (1860-1940), who had led a national church movement during the revolution of the Philippines against Spain in the early years of the war. Between them they developed the doctrine, polity and practice of the new church, which in time began to be called popularly the Aglipayan Church.

Because it was expedient to hide the political action of this group, attention was drawn to the religious aspects by radical departures from the doctrine of the Roman Catholic Church, although, in actual practice, these modernistic and rationalistic doctrines were never meant to be fully implemented.

From the very beginning of the schismatic church at a labor union meeting in Manila, August 3, 1902, American observers in the Philippines realized the political implications of this schismatic church and watched it carefully. Attempts of the Aglipayans to use church societies for subversive purposes were checked again and again. Church publications were screened and seditious articles were filed for future reference. Thus there grew up a documentary stockpile which would have made it possible for the United States to have outlawed the movement at almost any moment if necessary. However, it was to the advantage of the American authorities to convince the insurgent leaders that the United States guaranteed absolute freedom of worship and so the schismatic church, though proven subversive both in leadership and activities, was never banned. This tolerance on the part of American authorities was capitalized upon by the leaders of the Aglipayan Church time and time again and tended to give the impression of American approval.

When the Philippines achieved independence in 1946, the role of the schismatic church as a leading spirit in the independence movement was brought to an end. The spiritual poverty of its membership had been demonstrated and many adherents returned to the Roman Catholic Church. The remaining members split into two factions, one holding the rationalistic doctrines of the Aglipayan Church and the other seeking rapprochement with the Episcopal Church of the United States. This rapprochement required a revision of doctrine and polity which brought the schismatic church once more much closer to the Mother Church. As a result of this movement toward ecumenity and the calling of the Ecumenical Council by Pope John XXIII, studies are being made of many aspects of this movement. An understanding of the political basis for the schism is necessary for any understanding of the status of this church.

Microfilm \$7.55; Xerox \$26.80. 593 pages.

THE DOCTRINE OF THE INCARNATION
AND CHRISTIAN SOCIALISM

(Order No. 61-3093)

Norman Russell Coombs, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor George L. Mosse

The doctrine of the Incarnation--centering in the union of two natures, deity and humanity--became the theological basis for opposing an otherworldly Christianity and for developing a Christian perspective concerned primarily with redeeming society rather than individuals. In the middle of the 19th century Frederick Denison Maurice constructed his theology around the Incarnation which he interpreted in its cosmic sense rather than limiting it to the thirty-three years which Christ spent on earth. The Incarnation was interpreted to mean that God's method of revelation to men was by entering into natural, material forms. The Incarnation became an extension of Creation including the work of the pre-incarnate Logos by which God progressively revealed Himself until the climax in the Incarnation in Jesus Christ. God continued to reveal Himself to men through contemporary events. This view enabled Maurice and his disciple, Charles Kingsley, to accept developments in science, including evolution, as revelations of God. They also contended that social agitation, including Chartism, was inspired by God as part of the unfolding of His plan.

Interpreting the Incarnation as an evolving process of God's immanent working in mankind, the concept of the Fall became almost forgotten by them. Christianity's purpose was not to save individuals out of a corrupted race but to forward the uninterrupted social evolution directed by God. Maurice viewed the Incarnation in Christ as a revelation that He was Head of the whole human race. The concepts of the universal Fatherhood of God and the universal brotherhood of man were all important. They implied that association for the welfare of mankind rather than competition for personal gain was the basic social principle in the universe. On this basis Maurice and Kingsley favored the cooperative movement.

In 1877 the Rev. Stewart D. Headlam founded the Guild of St. Matthew to forward Christian socialism. The Guild based its study of social and political questions in the Mauricean doctrine of the Incarnation. Headlam and the Guild also integrated into their theology the principle of a Sacrament which they drew from the Catholic revival in the Church of England. The Incarnation taught the revelation of deity in natural, human form, and the Sacramental principle stressed the expression of invisible grace in visible, material symbols. These two principles were combined by Headlam to strengthen his belief in the essential unity of the spiritual and material and to connect religion to the problems of life on earth. The Kingdom of Heaven was defined as the righteous society established by Christ on earth and not somewhere in the clouds.

The socialism which Headlam derived from this theology was more drastic than Maurice's cooperativism. Influenced by Henry George, he made land nationalization the major plank in his platform. He also advocated the nationalization of the major means of production as well as a more righteous distribution of profits. Labor unions were accepted and encouraged as an important means for

a better distribution of wealth. However, Headlam viewed these material reforms as only the beginning of the Kingdom. These changes would provide the means for all people to develop their abilities to the full. The state was also to provide cultural and recreational facilities.

The theology which developed around the Incarnation in 19th century England provided the basis for a definite Christian socialism. On one hand it made peace with science and also enabled the welfare state to evolve without a clash with the Church. On the other hand, this theology minimized the doctrine of depravity and was severely challenged by the World Wars which contradicted its belief in God's progressive redemption of society and civilization.

Microfilm \$3.80; Xerox \$13.30. 294 pages.

THE LIFE AND THOUGHT OF
CHANG CHÜ-CHENG, 1525-1582.

(Order No. Mic 61-2098)

Robert Bruce Crawford, Ph.D.
University of Washington, 1961

Chairman: Hellmut Wilhelm

The Ming Dynasty had been in existence for over two hundred years when Chang Chü-cheng emerged in 1572 from humble beginnings to become Chief Grand Secretary under the young Emperor Shen-tsung and one of the most famous ministers in Chinese history.

During this long period, the dynasty had declined from its earlier vigour until by Chang's time it was faced with an extreme financial crises and constant Mongol invasions and raids by Japanese pirates which the government was compelled to meet with a virtually defunct army. Autocracy had tended to sap the initiative of officialdom, and with the decline in the quality of the Emperors, centralization of authority permitted the rise of eunuchs and the fluctuation in the locus of authority which did much to create the basis for power struggles within the bureaucracy. Intellectually, orthodoxy had gone far toward destroying the intellectual and political creativity of the scholars and officials and directed their energies into purely abstract philosophizing and away from the more practical needs of government. Orthodoxy was challenged by Wang Yang-ming but the radical wing of his school tended to question the validity of the imperial system itself. Many adherents of this school engaged in unconventional behavior and ignored Wang's admonitions about the unity of knowledge and action and over emphasized the validity of intuitive knowledge. Combined, the trend of events had brought the dynasty to the point where it seemed to be drifting and gradually dying from creeping paralysis.

Chang Chü-cheng was acutely sensitive to these developments. In his view, without immediate and vigorous action the dynasty would collapse. As Chang read his history and viewed developments within the Ming Dynasty, he saw the decline as originating in the failure to thoroughly implement autocratic principles. Scholars and officials, in his view, were retreating away from what he considered to be the essentially Confucian-Legalist nature of the dynasty. For him, the dynasty could survive only by returning to this basic nature.

In response to circumstances, Chang formulated a political philosophy which was intended to rationalize and revitalize autocracy and compel scholars and officials to return to a practical, pristine, Confucianism. This philosophy and the administrative measures formulated within his intellectual framework was called Legalist by many of his contemporaries and this characterization has been perpetuated by some modern students of his life. His writings do reveal Legalist influences, particularly in his great emphasis upon rewards and punishments and checking names and realities as the sole means of governing and in his minimization of the importance of ethical considerations. Such Legalist influences, however, are restricted to administrative techniques. In his attitude toward the purpose of the state and his economic views, Chang is Confucian. For him, autocratic government was the only government capable of providing the peace and security for the people which was the rational for the existence of government itself. In essence, then, Chang's philosophy and his political measures, are Confucian in principle and Legalist in application and thus in accord with the nature of the imperial system.

By his vigorousness, single-minded devotion to his principles, and his ruthlessness, Chang did give the dynasty a new lease on life. Ironically, however, he did much to strengthen the very factors of the decline he sought to avert and within a few years of his death all the good he had accomplished had been undone and the dynasty rapidly declined. Even Chang himself became the victim of the autocracy he idealized.

Microfilm \$4.10; Xerox \$14.40. 318 pages.

THE NEGRO UNDER THE
NEW DEAL, 1933-1941.

(Order No. 61-3124)

Allen Francis Kifer, Ph.D.
The University of Wisconsin, 1961

Supervisor: Merle Curti

An examination of archival materials pertaining to the Civilian Conservation Corps, the National Youth Administration, the Farm Security Administration and the various programs of the Work Projects Administration indicates that, during its first eight years, the New Deal had no fixed policy toward the Negro. The President himself remained very much in the background on racial matters. Franklin Roosevelt's closest link to American Negroes in general was through his wife, Eleanor Roosevelt. Except for occasional and indistinct signals from the President, and the more energetic activities of his wife, New Deal policy toward Negroes depended almost entirely upon the personalities dominant in the various departments and independent agencies.

The old-line agencies, like the Agriculture Department, the Extension Service, the Army, and the Office of Education, tended to treat the Negro, with his special economic and social problems, almost as if he did not exist. People who came to government service fresh, and for non-political purposes, held a broader commitment to securing economic relief for the Negro. Some of these people found

themselves much too busy with bigger problems to devote much time to those of the Negro. Frances Perkins, Harry Hopkins and Rexford Tugwell gave their energies to labor, and relief and community building in general, leaving the Negroes' special problems to others in their departments.

Those who made the greatest contributions to an atmosphere conducive to doing something for the Negro in depression were Harold L. Ickes, Secretary of Interior; W. Frank Persons of the Labor Department; Aubrey Williams of FERA-WPA and NYA; Clark Foreman of Interior; Hallie Flanagan of the Federal Theatre Project; and Will W. Alexander of the Farm Security Administration. These people brought into the executive branch more Negro administrators than any previous government. In addition to traditional political appointments, some thirty to forty Negro New Dealers came to Washington before 1936.

The most outstanding of these Negro New Dealers was Mrs. Mary McLeod Bethune, who through a network of Negro administrative assistants in the states, exerted significant influence over NYA programs in behalf of Negro young people. Robert C. Weaver, in the Interior Department, and Joseph H. B. Evans and Constance E. H. Daniel of the Farm Security Administration, were a few of those Negro advisers who, though never in positions of policy, had superiors willing to listen to their suggestions concerning specific needs of the Negro. In some agencies, however, Negro New Dealers were frustrated in their efforts, because they were excluded from planning activities, and by the inability of the agencies for which they worked to cope with the great needs of the Negro.

All these people were receptive to pressure and suggestions from organizations outside government interested in the welfare of the Negro. Yet, in their attempts to bring economic succor to Negro Americans, these people faced incredible odds in the impersonal forces at work in the administration of programs like AAA and NRA, in the decentralized nature of most of the New Deal relief programs and the subsequent dependence on state and local administrators, and in a largely segregated America of the 1930's accustomed to discriminatory acts against Negroes.

Microfilm \$3.90; Xerox \$13.75. 303 pages.

THE SOCIAL GOSPEL AND THE NEW
SOCIAL ORDER, 1919-1929.

(Order No. 61-2965)

William Finley McKee, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Merle Curti

For more than half a century the Social Gospel represented the most significant expression of the social conscience of American Protestantism. Originating in the closing decades of the nineteenth century, reaching its maturity during the Progressive movement preceding the first world war, it reached its climax during the depression of the 1930's. During the 1930's the Social Gospel was attacked by theological critics who accused it of being hopelessly optimistic and utopian, and by the end of the decade it was largely displaced by neo-orthodox social Christianity.

This study is an examination of the developments of the 1920's which intensified the optimism and utopianism of the Social Gospel and prepared the way for the crisis in Protestant social liberalism. It is concerned primarily with the central ideal of the movement, the quest for the New Social Order which would embody the Kingdom of God.

The history of the Social Gospel during this period was examined through a study of the records of denominational assemblies; the records and publications of church organizations which were committed to social Christianity, such as the Federal Council of Churches and the Methodist Federation for Social Service; religious periodicals which were concerned with an expression of the Social Gospel, including the *Christian Century*, the *World Tomorrow*, and the *Social Service Bulletin*; and the publications of prominent leaders of the Social Gospel.

During the decade following the first world war the Social Gospel was transformed from an evangelical crusade for the Christianization of society into a utopian quest for a New Social Order. The ideal of the Kingdom of God was identified with a Cooperative Commonwealth which would be based upon the motives of service and brotherhood. The New Social Order was regarded as an immediate historic possibility which was to be achieved by implementing an ethical strategy of love. At the close of the first world war the ideal seemed to be a present reality in millennial expectations of a New Social Order developing out of the ruins of the war. When the post-war years passed without the fulfillment of this hope, the ideal of the New Social Order continued to be elaborated as the goal for social reconstruction. It was increasingly identified with concrete programs for economic reorganization, ranging from welfare capitalism to democratic socialism.

Since the ideal of the New Social Order stood in sharp contrast to the existing economic system, the Social gospel sharpened its critique of capitalism. Becoming more realistic in its economic analysis, it developed a better understanding of the complexities of economic organization. But it coupled this with a moralistic critique of the ethic of capitalism, centering around an ethical attack upon competition and the profit motive, which contributed to the utopianism of the Social Gospel.

The Social Gospel acquired an international dimension during the first world war, becoming committed to the establishment of a peaceful world order. During the 1920's it continued to support the creation of international machinery for world peace. Reacting against its support of the first world war, it renounced war in a way which prepared for its later isolationism. The Social Gospel also became associated with liberal pacifism, which carried to an extreme its optimistic views of human nature, history, and the possibilities of the ethic of love. All of these developments intensified the utopianism of the Social Gospel and contributed to the crisis of the 1930's.

Microfilm \$5.95; Xerox \$21.20. 467 pages.

HISTORIANS' INTERPRETATIONS OF THE RECONSTRUCTION PERIOD IN AMERICAN HISTORY

(Order No. Mic 61-1106)

Robert Joseph Moore, Ph.D.
Boston University Graduate School, 1961

Major Professor: Kenneth A. Bernard

Since 1900 there have been three distinct interpretations of Reconstruction--the traditional or "Dunning" interpretation and two major revisions, each demonstrating that changing climates of opinion in American society have vitally affected historians of Reconstruction.

Near the beginning of the century historians were expected to answer questions on politics and the Constitution. The doctrine of white supremacy, as manifested by disfranchisement of Negroes and crystallization of the segregation system in Southern states and by the United States' involvement in imperialism, was reaching its peak. Furthermore, emphasis was on conciliation between North and South rather than equality of races. These influences produced the "Dunning" interpretation.

Historians of the "Dunning" school emphasized politics and the actions of individuals; believed in the inferiority of the Negro; sympathized with Southerners oppressed by unwise, harsh, and destructive Radical policies; and sharply criticized the motives and methods of Radical leaders.

For approximately four decades the "Dunning" concept was the dominant interpretation of Reconstruction, but by the mid-1920's notable revisionist viewpoints had begun to appear. In the following decades revision was encouraged by several developments in American society--increasing interest in economic and social reform, expanding use of the federal government as an agency for social welfare, scientific claims concerning the essential unity and equality of the races, and the Negro's crusade for equality of rights and support of this drive by many whites. The revisionist views have become dominant in Reconstruction historiography, despite essential conformity to the traditional interpretation by some "latter-day Dunning" historians.

Revision is of two major types--economic and racial. The economic or "Beard-Beale" interpretation represented Reconstruction as the period in which industrialism made secure its triumph over agrarianism. The "Beard-Beale" historians emphasized economic forces and minimized the influence of individuals. Seeing Reconstruction as a natural consequence of economic transformation and war, they tended not to condemn the Reconstruction process, as had the "Dunning" school. In fact, Marxian extremists of the economic school saw Reconstruction as an exhilarating, revolutionary experiment in democracy which, alas, had ended in reaction and the destruction of democracy.

Racial revisionists stressed the humanitarian motives of Reconstruction leaders and emphasized Negro progress despite many obstacles. They declared, contrary to the "Dunning" school, that Negro participation in Reconstruction politics had not been disastrous.

As a result of the research and writing of the revisionists, a brighter picture of Reconstruction has been created. Characterization of Reconstruction as a period of progress, social experiment, and advanced racial thinking has largely

replaced the "Dunning" emphasis on Carpetbag-Scalawag-Negro misrule, corruption, and oppression of Southern whites.

As the "Dunning" interpretation was, after several decades of investigation, overshadowed by revision, so likewise economic revision has been modified by recent critics of its monolithic approach to causation. But, in contrast, as social and political currents continue to support the Negro's approach to a status of equality, the racial or "humanitarian" interpretation has become more significant and influential.

Microfilm \$7.85; Xerox \$27.90. 618 pages.

THE ROLE OF HENRI DE BLOWITZ IN INTERNATIONAL AFFAIRS, 1871-1903.

(Order No. Mic 59-6950)

Thomas Eugene Mullen, Ph.D.
Emory University, 1959

Henri de Blowitz served as Paris correspondent of The (London) Times from 1871 until 1903. Richly endowed with the talents essential to success in his profession, he became one of the most famous and respected foreign correspondents of his day. He won the confidence of numerous outstanding figures in French and European politics. He associated on terms of equality with prominent diplomats representing all the great powers. While defending the policies of his informants and occasionally providing a channel for calculated "leaks," he obtained exclusive information for The Times, the most influential newspaper of the period. His disclosures not infrequently exerted considerable influence upon international relations in general, and upon Anglo-French relations particularly.

The present study seeks to answer, by examining the work of a particular correspondent, certain questions that are basic to the general problem of the role of foreign correspondents in international affairs. First, from what sources did Blowitz obtain information and how did he gain access to those sources? Second, to what extent and in what ways did government officials attempt to use him in order to further their aims in foreign affairs? Third, what influence did he have upon international relations?

Among Blowitz's sources of information were a number of the leading figures of the Third French Republic, including Thiers, Decazes, Waddington, Gambetta, and Freycinet. Many of the ambassadors accredited to the French government, for example Hohenlohe of Germany, and Lytton of England, gave him friendly hints and "inspirations" from time to time. Occasionally he obtained information from French ambassadors abroad. In every case of this kind, the correspondent gave favorable publicity to the ideas of his informants, and he often placed the individuals themselves in the most favorable light. Undoubtedly this was a prime factor in his success in gaining information.

The informants themselves had various aims in supplying the correspondent with material. French foreign ministers, like Decazes in the "War Scare" of 1875, generally sought to win foreign opinion to the side of France as against Germany or another enemy of the moment. Ambassadors often sought to promote better relations be-

tween their own country and that to which they were accredited. Occasionally there is evidence that they used Blowitz to publicize information that would embarrass opponents in a particular negotiation. During the Congress of Berlin in 1878, Bismarck himself made use of the correspondent in an effort to influence English public opinion.

That Blowitz personally exercised influence upon ministers and diplomats is clearly shown in the reports forwarded to Bismarck by Hohenlohe, and in the private correspondence of the British foreign secretaries, Granville and Salisbury. Hohenlohe had great respect for the correspondent's opinions, as well as for the accuracy of his information. The same was true of numerous other diplomatic representatives. Blowitz on more than one occasion forwarded information to The Times before British diplomats sent it to the foreign office. The prestige attaching to the correspondent's success in obtaining early and accurate information was undoubtedly one of the principal reasons for his influence in international affairs.

Microfilm \$4.20; Xerox \$14.85. 326 pages.

A HISTORY OF THE NEGRO IN MINNESOTA

(Order No. Mic 61-2722)

Earl Spangler, Ph.D.
The University of Oklahoma, 1961

Major Professor: Dr. Gilbert C. Fite

In a state where minorities have played such an important role in the development of culture and society, it seems only just that the Negro's history should be part of the total. This study is an attempt to survey the struggle of a small minority of people as they strove to become first-class citizens.

The American Negro is our oldest minority, with the exception of the American Indian. He has been intertwined with the history of the United States from Jamestown to the present. All too often, he has been portrayed as a Southern "problem," but this is no longer true, if it ever were. His struggle to achieve equality in America has become part of the struggle by minorities, particularly those of color, to do the same thing in world society.

The Negro, unlike most other groups in Minnesota, has not been conscious of his own history and role in the state. He has made few major efforts to preserve the variety of sources so vital to the preservation of the history of a people. One of his greatest achievements along this line has been the maintenance of a Negro press since 1885 which constitutes a major source on his activities and institutional life.

The Negro was present in Minnesota in the early fur-trading days and has played a role, direct or indirect, in the history of the Territory and State ever since. The Negro population of Minnesota grew from 39 in 1850 to 14,022 in 1950, a sizable growth but still a very small minority of the total population. He has been held in slavery, freed by court action, given legal, educational and suffrage equality, held public office, including the state legislature, and contributed to business, industry, and professions in his communities. His institutions, such as

the National Association for the Advancement of Colored People and Urban League, have been exceedingly active and effective in furthering the progress of the Negro in Minnesota. In essence, he has been a "catalyst" of American democracy in Minnesota, as elsewhere.

The history of the Negro in Minnesota indicates that a minority which always has been a very small part of the total population can have an impact on the history of the

state. In addition to the role noted above, an anti-lynching law and the enactment of a Fair Employment Practices Act give further credence to the place of the Negro in a Northern state where race prejudice has always existed but now appears to be on the wane. Such success in establishing this atmosphere speaks well for both white and Negro residents of the state.

Microfilm \$3.10; Xerox \$10.80. 240 pages.

HOME ECONOMICS

DEVELOPMENT OF AN INSTRUMENT
TO DETERMINE VALUES
OF HOMEMAKERS

(Order No. 61-3040)

Eleanore Louise Kohlmann, Ph.D.
Iowa State University of Science and Technology, 1961

Supervisor: Mary S. Lyle

The study had as its major purpose the development of an instrument which could be used by home economics teachers, extension workers, and adult study group leaders to identify values of homemakers.

After making a critical examination of the characteristics of personal values, it was concluded that values are concepts of the desirable, which are distinctive of an individual, and influence his behavior. They may be explicit, that is, readily expressed or asserted, or implicit, needing to be inferred from his behavior. Values may be either positive or negative depending upon the connotations they have for the well-being of the individual. Values may be regarded both as means and ends of action.

The initial step in developing the forced-choice instrument, which was entitled "My Portrait as a Homemaker," was selecting the values to be explored. Those included were: concern for others, economy, education, family life, friendship, health, status, and work efficiency. A pool of behavioral descriptions, believed to be related to the eight values, were then collected from professional and non-professional literature, from talking with others who worked closely with homemakers, and from observations of homemakers in different situations.

To control the validity of the instrument, the behavioral descriptions of items were sorted, according to the value believed to be represented by the item, by four judges working independently. Only those items for which there was agreement among three of the four judges were retained.

A crucial step in the construction of the instrument was

controlling the social acceptability of the items. In order to do this, a social acceptability index and an index of ambiguity were computed for each item. These indices were obtained by means of a check list, composed of all items, which gave the respondents, who were graduate students at Iowa State University of Science and Technology, five opportunities to check to what degree they thought a homemaker would like to be described by each item. Indices of ambiguity for the items ranged from .26 to 2.13. Items having the largest amounts of dispersion as shown by indices of 1.15 or greater were discarded.

When combining the items to form the forced-choice instrument, items representing different values but which had like or similar social acceptability indices were paired. The items included ranged from 4.98 to 1.13 in social acceptability index but the deviation scores of the two items in each pair ranged from .00 to .46, with only 6 per cent having scores greater than .20. Each value was paired with each other value three times and was represented in the instrument 21 times.

For purposes of testing the instrument, 146 homemakers from two rural and one town area were asked to respond to it. The values, health and family life, received the two top mean scores for both the rural and the town homemakers. Mean scores indicated there were some differences in the importance given to the various values when the instruments were sorted according to the age and amount of formal education of the homemakers. Analyses of variance indicated, however, that the values considered important were not necessarily influenced by the age of the homemaker or where she lived.

Insofar as it was possible to determine, the instrument is believed to be a valid measure of the eight values. The mean coefficient of reliability as tested by the "split-half" method was .47. The instrument, therefore, appears to be one that can be used with groups of homemakers and that is worthy of further refinement. Checking the instrument appeared to be a satisfying and enjoyable experience for the homemaker.

Microfilm \$3.00; Xerox \$10.35. 230 pages.

LANGUAGE AND LITERATURE

LANGUAGE AND LITERATURE, GENERAL

THE LIFE, WORKS, AND LITERARY RELATIONSHIPS OF CHARLES LLOYD: A BIOGRAPHICAL STUDY.

(Order No. 61-3078)

Ruth Isabelle Aldrich, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Carl R. Woodring

This study, growing out of an interest in the connection of Charles Lloyd (1775-1839), the minor romantic poet and novelist, with the "Lake Poets" Wordsworth, Southey, and Coleridge, was an endeavor to assemble for the first time a complete picture in chronological form of the facts of Lloyd's life and the contemporary criticism of his work, drawing on records, unpublished letters, and the widely scattered and brief comments of many writers.

A second objective was to show as far as possible the relationship Lloyd bore to Southey, Coleridge, Wordsworth, and Lamb, and to suggest through excerpts from his writings and letters new glimpses into their personalities. In addition it has been possible to correct some minor misapprehensions about these relationships, such as the undue emphasis usually placed on Lloyd's stay with Coleridge at Nether Stowey.

A final purpose was an attempt to illustrate, in the work of Charles Lloyd, changing trends in the literature of the time, for Lloyd was another of the transitional writers who bridged the political, poetical and stylistic gulf between the eighteenth century and the romantic period.

In plan, chapter 1 provides the background of the Lloyd family; the remaining chapters present in turn the external events of a period of Lloyd's life, followed by a discussion of his work for that period. Letters have been used wherever possible in order to let events and personality unfold naturally. Important works are summarized, with illustrative passages given. Critical reviews have also been summarized briefly.

Lloyd was a minor writer of some versatility, his works including two novels, a tragedy in blank verse, two long narrative poems, blank verse translations of the tragedies of Vittorio Alfieri, several volumes of shorter poems, and what might be called two public epistles, one in prose and one in poetry. Born as the last quarter of the eighteenth century opened, he began by imitating Cowper, Beattie, Goldsmith, and Gray, by quoting Akenside and Bowles; at the turn of the century he was influenced by Wordsworth, Southey, and Coleridge and was refuting William Godwin's principles in his first novel; in his last volumes, early in the 1820's, he imitated Byron and Keats and took part in the widespread controversy over the rank of Pope as a poet. His poems illustrate the movement from the quatrain of Gray's *Elegy* to the conversational blank verse poems of the great romantics, from the revival of the ballad to the ottava rima stanza of *Beppo* and

Don Juan his subject matter shifts from the social consciousness of Holcroft and Godwin to the Wordsworthian emphasis on nature, then to the romantic interest in Boccaccio and the contemporary comments as in *Don Juan*.

Limited in power and talent, Lloyd's work was not destined to endure in English literature, but his writings, beliefs, and theories illustrate the currents of his day and the influence of his greater friends.

Microfilm \$5.45; Xerox \$19.35. 426 pages.

A HISTORY OF THE LEXINGTON THEATER FROM 1887 TO 1900

(Order No. Mic 61-291)

John Coleman Arnold, Ph.D.
University of Kentucky, 1956

Director: Grant C. Knight

This study of the Lexington stage was designed, first, to present an accurate and detailed account of all professional happenings at the Lexington Opera House during the years from 1887 to 1900, and, in the second place, to point out, as far as possible, significant trends in what was at that time a typical American theatrical province. The problem has been to register the awareness of Lexington audiences to the first important transitional ideas then disturbing old world centers and the degree of willingness among theatrical managers in America to participate in a more naturalistic theater just beginning to challenge the romantic dramas which had dominated the nineteenth century stage.

In 1887, Lexington, still known by many as the Athens of the West, erected and inaugurated a new theater building on North Broadway. It was a magnificent house for the times, with a seating capacity of twelve hundred and a stage capable of handling the elaborate productions then touring the provinces in increasing numbers. Immediately Lexington became one of the more prosperous stops in the Midwest.

From 1887 to 1893 the Lexington stage was monopolized by sensational and sentimental melodramas, light operas, and comedies of a legitimate or semi-legitimate nature. Farces, imitation restoration comedies, and rowdy comic operas showed decided increases during the depression years of 1893-1896. At the same time there was a decrease in the number of sensational and heroic melodramas, grand opera appearances, and Shakespearean productions. As the clouds of economic depression lifted, Lexington theatergoers showed a preference for realistic farces and comedies, generally without messages of any kind. Charles H. Hoyt, the country's leading writer of farces, who consciously adjusted his mild satires to the demands of the audiences, became more popular in Lexington. Also the record indicates that emotional concoctions

of the *Camille* type rather than studies of the Ibsen, Shavian, or Sudermann kinds engaged the interests of Lexington's elite, while brittle farces, sensational melodramas, and elaborate minstrels seemed to satisfy the "gallery gods."

The reason for this lack of tolerance for exposition and discussion drama seems to have been of a three-fold nature. First, the Lexington community, like many others outside metropolitan areas, was too close to its frontier beginnings to accept the subtleties of a mature stage. In the second place, conventional purists among the critics supported a sentimental, action theater. Chief among these was William Winter, who, from his vantage point on the New York *Tribune*, met with telling invective every invasion of the Ibsenites. A third bulwark against a free theater was found in the great Klaw and Erlanger Syndicate, which insisted on popular escapist drama and looked with suspicion on all productions with doubtful box office appeal. It was largely responsible for the preponderance of spectacles, comic operas, and popular melodramas which came to Lexington during the nineties.

Thus what cultural aptitudes for a more significant drama the Lexington community might have had remained dormant during the transitional years while a native love for farce, a subservience to a Victorian critical hierarchy, and a failure to cut loose from the domination of the Syndicate largely determined what the people of Lexington saw at their Opera House.

Microfilm \$5.65; Xerox \$20.05. 443 pages.

WILLIAM MORRIS' TREATMENT OF SOURCES IN *THE EARTHLY PARADISE*.

(Order No. Mic 61-266)

Ralph A. Bellas, Ph.D.
University of Kansas, 1960

Criticism of William Morris' *The Earthly Paradise* has been characterized by widespread disagreement concerning certain qualities of the poem and by a common failure to evaluate the poem in terms of Morris' own conception of it. In the present study Morris' treatment of his source materials is used as the basis for a detailed analysis of the poem.

Contrary to general contention, Morris followed a rather deliberate process of accepting, rejecting, and modifying elements of his sources. For the classical tales, though Morris made some use of Lempriere's *Classical Dictionary*, his indebtedness to it seems to be exaggerated. He depended on more fully developed classical accounts of individual stories, on legends as they shaped themselves in his mind from his fairly extensive reading in classical literature, and on medieval and modern renderings.

The terse narrative, sometimes dramatic, method of many of his primary sources is replaced by one that is diffuse. Much of the sensationalism is either subdued or eliminated, and in general there is a softened handling of incident and character. Instead of emphasizing events in the narratives, Morris emphasizes lyrical elements. Feelings of characters are analyzed and elaborated to an extent foreign to the classical sources. In particular love

motifs are expanded and treated in the manner of medieval romance, but without the sophistication of the courtly tradition. In addition, most of the heroes and heroines possess an introspective tendency that is out of keeping with their original characterizations and that represents a modern strain in the tales. This introspective tendency, an apparent genuineness of sentiment, and a clarifying of motives give the characters greater depth than they usually had in the sources. It is not Morris' purpose, however, to individualize his characters into completely independent existence. He goes as far as credibility demands, but he is more concerned with depicting a type which, with a fair degree of consistency, will serve the poem as a whole.

The Greek gods still play a part in Morris' medievalized versions of the legends, but it is a less significant part, generally considered. Their intercession in the affairs of man is not so capricious as it tends to be in the ancient myths. But the humanizing of the gods is carried further than even the classical writers would permit themselves to go. Because of this the people of Morris' tales regard the gods with less fear and awe than is the case in classical literature. Certainly they have lost most of their deifying qualities.

Nevertheless, the spirit of Morris' classical tales is more akin to Hellenism than to medievalism. It is a spirit fostered by an awareness of the beauty in the natural world and life, combined with a realization of the mutability of all things and of the inevitability of death. It is a spirit in part also fostered by a submissiveness, though not abandonment, to fate. This spirit produces a mood identified in the poem as "bitter-sweet."

Since the setting for *The Earthly Paradise* is the fourteenth century and since Morris wanted the poem to be a series of romantic narratives retold in the medieval tradition, his task of adapting the stories based on medieval sources was not so great as with the classical stories. In almost every tale Morris proves superior to his sources in fusing the realistic and the fanciful, in creating an atmosphere appropriate to the action, and in improving the plausibility of the action, while at the same time retaining the narrative frame and the wondrous nature of the originals. His most difficult problem, perhaps, was in adjusting the spirit of the medieval tales to the fundamentally Hellenic spirit of the entire poem. Considering the great diversity of the stories, however, there is a remarkable consistency of treatment. Even the two tales based on sagas, "The Lovers of Gudrun," and "The Fostering of Aslaug," do not illustrate any marked divergence from Morris' romantic manner in the rest of the poem.

Morris styled himself an "idle singer," and he has been regarded as a raconteur who escaped into the dream world of his tales. Too great an emphasis, it is suggested, has been given to the escape rather than the interpretive values of the poem. Indeed, in spite of the medieval setting and manner, the interests of the poem are not so remote from those of Morris' own life as critics have declared. In the tales class distinctions are minimized, the state of the world is criticized, the Golden Age theme is emphasized, and love and friendship are regarded as the means of achieving a fuller and happier life. These interests show that the poem cannot be viewed apart from the writings of Morris in which he expressed a concern for the betterment of man and society. *The Earthly Paradise*, it is concluded, occupies a more significant place in the pattern of Morris' development as

a thinker and writer than critics have been disposed to give it. Microfilm \$4.95; Xerox \$17.55. 386 pages.

**THE SHEPHEARDES CALENDER, 1579-1611:
A BIBLIOGRAPHICAL SURVEY.**

(Order No. Mic 61-1564)

Richard Kennedy Brown, Ph.D.
Fordham University, 1961

Mentor: Erwin W. Geissman, Ph.D.

This is both an analysis, in bibliographical terms, of a typical Sixteenth Century text, and an essay in bibliographical method. For it is not merely an enumeration of the variants in the orthography and punctuation of Spenser; nor again only an examination of compositorial or typographic characteristics, or of possible influences on the printer's copy. It is these; but it is also an attempt to scrutinize the terms of bibliographical inquiry, and assess the nature and limits of such inquiry.

The investigation is literary to the extent that it is concerned with a peculiar diction and special poetic forms, and may even aid in particular emendations. It is also philological, or linguistic, to the extent that it necessarily considers phonetic relationships--especially among the most frequent spelling variants, the vowels--as well as standards of orthography and punctuation. And it is typographic to the extent that it considers the conditions connected with printing the text, and its physical form. It is in short bibliographical, not in the sense of establishing a "substantive" text--since just such a text was selected--but in discerning, through the various kinds of evidence, what stands between the author's holograph (or that directly printed from it) and the text of each edition.

It begins with the question of the classification of variants, distinguishing in various categories between the "substantive" or those deliberate changes which affect the sense and are probably due to editorial correction, and the "accidental" or merely mechanical due largely to the compositors' mishaps. In the course of this discussion, the problem of "modernization" is explored, and it becomes evident that the term has not yet been sufficiently clarified: that in fact no variant can be considered other than a "noncommittal" typographic change unless it demonstrates a clear tendency, after analysis with reference to an established standard of usage, to either modernization or the reverse. However, it also becomes evident that the unequivocal establishment of such a standard is seriously hampered by a dearth of scholarship on the subject, and variants must be analyzed with a restricted frame of reference.

These variants fall into four categories; in order of frequency: spelling, punctuation, "substantive" and typographic changes. Analysis of spelling variants reveals that among the vowels there is little conclusive evidence of modernization, and some considerable instances of the opposite; while among the consonants there is a clearly discernible modernizing trend; and though the errors and corrections in spelling are inconclusive in this respect they reveal the editor's hand in some editions, in addition to careful printing in the earlier ones. Likewise, the

punctuation variants reveal neither a recognized standard of usage nor any clear trend, but do show careful correction and printing in most editions; and the special class of "substantive" variants indicates little modernizing editorial correction but careful printing in several editions, while the typographic variants show careful printing and little correction.

These definable results lead to broader conclusions: that only the spelling variants give reliable evidence of any generally recognized standard of usage in the late Sixteenth and early Seventeenth Centuries; that throughout this period much less heed was paid to punctuation than to spelling, suggesting that what we might consider error is simply lack of adherence to any standard, in turn suggesting the general competence of correctors and compositors.

Such conclusions also bring us back to the crucial questions of modernization and a frame of reference, and point to the lack of sufficient evidence based on the comparison of texts reflecting a recognized standard of usage and involving not just a few thousand, but--as in the present instance--hundreds of thousands, of variants.

Microfilm \$2.90; Xerox \$10.15. 223 pages.

THE POEMS OF STEPHEN HAWES

(Order No. 61-3022)

Sam Fields Freeman, Ph.D.
The University of Oklahoma, 1961

Major Professor: Paul G. Ruggiers

The known poems of Hawes have never been collected and published in a single edition. Undoubtedly because of the unavailability of such a text, the entire canon of the poet has never been surveyed. Of the five works known to have been composed by him, only one has received any lengthy treatment by critics, treatment primarily concerned with source studies.

The chief concern of the present study has been to collect all available comment on Hawes, both that of a biographical nature and that of a critical one, and subsequently to present an explication of each of the poems, revealing Hawes's poetical devices, themes, stylistic treatments, and poetical purposes.

Such a treatment ultimately lends itself to an appraisal of the art of the poet; consequently, Hawes is examined in the light of poetical theory of his times and also in the light of modern times. This study maintains that within the scope of the poetical theory which Hawes was practicing, he is a very capable poet, showing himself to be imaginative, inventive, creative, experimental, and adept at rearranging and refurbishing traditional devices. The poetical theory itself is not one of timeless appeal and approval. Thus, when the poetry of Hawes is compared with literature which is not doctrinal, he indeed seems limited and dated.

Concomitantly, an examination of the works of Hawes reveals the hopeless confusion of poetical diction at the turn of the fifteenth century and the problems of versification created by a language still fluctuating and changing radically, confusions and problems Hawes was fully aware of and interested in remedying. It reveals the tendency of

the times to adhere desperately to the traditions and learning of the past. In the case of Hawes, the tendency amounts to a slavish reliance upon the established precedents of Chaucer, Lydgate, the academic philosophy of the liberal arts, church doctrine, and the Bible. Each of these precedents is investigated, and the use, purpose, and effectiveness of each are assessed.

Finally, this study traces the development of poetic technique as Hawes matured. A theory is advanced that each of the poems is a special treatment of a single basic theory of poetry, that of "moral purpose hidden in cloudy figure," a theory ultimately traceable to Boccaccio. Such a view of the poet also sees him as one of the first poetical theorists of English letters. The poems, arranged chronologically, are seen as progressively advancing applications of this theory of "the cloudy figure," the last poem a more complex demonstration of it than the first. The concluding pages of the study analyze the poetic successes of Hawes in terms of his unique treatments of the poetic theory, but simultaneously maintain that the theory also accounts for the majority of his failures.

Microfilm \$3.00; Xerox \$10.35. 229 pages.

JARGON TRANSMUTED: ALCHEMY IN
CHAUCER'S CANON'S YEOMAN'S TALE.

(Order No. Mic 61-1569)

Joseph Edward Grennen, Ph.D.
Fordham University, 1960

Mentor: Grover Cronin, Ph.D.

Criticism of the Canon's Yeoman's Tale, because of arbitrary approaches and emphases, has failed to agree even generally on the poem's basic meaning. Since the structure of the poem as a whole has invariably been ignored, and the poet's underlying vision unexamined, a new investigation of the tale's structure appears overdue.

Efforts to provide a meaningful context for the tale by examining alchemical traditions and treatises, and the statements of moralists, are soon met with the realization that alchemy was, despite sporadic attempts to make it empirical, a pseudo-science. Confusion and failure in the laboratory, and charlatanical deceptions, matched the mystification of alchemical authors and their merely rhetorical amplification of erroneously conceived theories. Although the possibility of transmutation was admitted by authoritative thinkers the fourteenth century saw a total lack of unanimity in theory and practice, and numerous attacks against alchemists.

The Yeoman's farcical catalogue is obviously an alchemical mélange, but other (hitherto unrecognized) technical terms are wielded deftly by the poet for ironic effect, "flee the fyres hete" and "preue," for example, Chaucer's versions of the terms ignem effugi and probare. Their use reveals an underlying comic vision by which the alchemists are seen (ironically) as acted upon by a "cosmic" alchemy (which their own theories can be enlisted to support). Chaucer uses verbal polysemes to keep several contexts (e.g. proverbial wisdom, alchemical theory, alchemical practice) in parallel, for ironic comparison.

The formulaic repetition, in alchemical treatises, of old notions reveals them as standard commonplaces, or topoi. When various topoi (e.g. "secrecy," "privacy," "unity" topoi) are identified the prologue is seen as a series of similarly ironic variations on these clichés, the structure of the prologue as an ironic application of the "trustworthy-associates" topos. A "list-of-false-substances" topos and a "multiplication" topos are combined in the Yeoman's catalogue, caricaturing the logorrhea of the "philosophers"--and newly defining the term "multiplye." The explosion is an ironic thrust at the "care-of-the-fire" topos and an enlargement of "multiplye." Prima Pars builds to an ironic vision of alchemy as formless multiplicity in contrast to the ordered unity asserted by the "philosophers."

The structure of the alchemical treatise as a whole is also "typical"--a commonplace--a two-part arrangement, usually a "practical" section, followed by an "allegorical" revealing the operation in cipher. This mystical jargon had by the end of the thirteenth century grown into an allegorical exposition based on Christ's passion--by the sixteenth, an alchemical "mass," in substance (if not in intention) sacrilegious. The relationship between the parts of the tale suggests its origin in the structure of the alchemical treatise, and the story of the gulled priest can be read not merely as an exemplum on greed but as an "allegory" presenting the eventuation of alchemical theory in an act which perverts the sacerdotal function, thus commenting ironically on the distorted religiosity of the treatises.

The Second Nun's Tale can now be seen to stand in a more essential relationship with the Canon's Yeoman's--a part of the same basic vision. Images suggesting unity, wisdom, and faith contrast with the alchemists' multiplicity, folly, and credulousness; the "good werkynge" of Cecilia with their misguided "werkes" and malconceived "Werk"; the harmonious microcosm which is the saint herself with the explosive microcosm of the alchemists. Details in the apocryphal legend of St. Cecilia suggest a possible source in the Gnostic legend which produced the alchemical allegory of the "chemical wedding," but even if true it would only help to explain why Chaucer might associate St. Cecilia with alchemy more easily than we. The faith and wisdom which Chaucer saw in St. Cecilia may be his retort to the alchemists' folly.

Microfilm \$3.50; Xerox \$12.15. 270 pages.

A CRITICAL EDITION OF THOMAS LODGE'S
A FIG FOR MOMUS (1595).

(Order No. 61-3155)

Wesley Dennis Rae, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Merritt Y. Hughes

A Fig for Momus was first printed in 1595, but no reprint appeared until 1817, when A. Boswell issued the poems as Number 3 in the series Fronde Caducae. The only other printing is in Edmund Gosse's collection of Lodge's works in four volumes for the Hunterian Club in 1883. The present edition is based on microfilms of the

first edition and has been collated with the other texts. The introduction contains sections on the satires, epistles, and eclogues, and the text is supplemented with explanatory notes.

A Fig for Momus introduced Roman types of the formal satire and epistle to English literature. The eclogues are modelled on classical pastorals as well, but they have nearer relatives in Spenser's Shepherd's Calendar and Drayton's Shepherd's Garland. In the satires, Lodge attempted to reproduce the urbane style of Horace's satires and combine it with the harsh realism of the satires of Juvenal and Persius. The attempt was not altogether successful, but Lodge did succeed in clothing with Satura Luciliana the skeleton of English satire as it had grown up with Langland, Chaucer, Skelton, and Spenser. The wide variety of subjects, and the dactylic hexameter exchanged for English couplets brought to native satire two of its most distinguishing features.

Lodge says of his epistles, "they are in that kind, wherein no Englishman of our time hath publickly written," and if Wyatt's verse letters are considered satires, Lodge's epistles are the first in English. He has again taken the keynote from Horace; the epistles cover a wide range of subjects, from cures for nightmares to praise of dogs, and they show some of Horace's familiar tone, although they cannot claim to be "urbane." Several of them supply a good key to Lodge's readings and his reliance on imitation, that "servile imitation," he complains, "where-with heretofore I have been vniustlie taxed." The epistle on dreams illustrates his growing interest in medical subjects as it collects from myriad sources causes and kinds of dreams, and as it surveys the effects of divination through the movements of stars, planets, and celestial beings, both angelic and diabolic. Epistle 7, "The Anatomie of Alchemie," follows a long tradition of those who satirized alchemy from Sercambi and Petrarch to Chaucer; the material has been lifted from Agrippa's De Incertitudine, in some parts almost word for word.

The four eclogues are not pioneers, since the pastoral in English was already well established by 1595. They are, however, distinguished by their serious tone; there are no lovers' complaints or song fests. Lodge no doubt relied on Spenser's Shepherd's Calendar: "February," "May," "October," and others furnished models for weighty pastorals such as Eclogue 3, in which he hints that his literary career is over, for there are few fit readers, and patrons "skantle learning with a servile pay." In 1596 the hint became reality as he published his last literary works.

From his extensive and varied readings, Lodge borrowed the materials for these poems, bringing to English literature its first taste of Latin verse satires and epistles. In a final gesture of defiance, he tossed the fig to Momus; unfortunately it did not choke that carping critic: A Fig for Momus was received unkindly, and Lodge gave up his literary career to study medicine.

Microfilm \$2.75; Xerox \$9.70. 212 pages.

THOREAU'S IMAGERY AND SYMBOLISM

(Order No. 61-3167)

Walter Lewis Shear, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Henry Pochmann

This thesis focuses on the relationship between Thoreau's expression and meaning, the chief formal elements of expression being images and symbols and the meaning of a philosophy which attempted to encompass as much of life as possible. Many of the problems involved in this relationship are defined by Thoreau's conception of the identity of art and life. The first chapter, which deals with his esthetic theory, points out that, for Thoreau, both art and life had esthetic experience as a common denominator and therefore both tended to be concerned with the interaction between the individual and the universe. Since the universe was an illustration of the workings of the Divine, both actuality and the words which denoted that actuality referred, for the individual who was sensitive enough to perceive them, to higher meanings. For Thoreau the green and blue colors in Walden pond were indications of its earthly and spiritual nature. At its optimum, esthetic experience would reflect universal meanings, those applicable to all men in any period of history. When Thoreau equates animal life with animal heat, he feels the conclusion he has drawn from his own experiences with the seasons applies not only to him and his contemporaries, but to the primitive savages as well. Frequently, as noted in the chapter on imagery, Thoreau resorted to traditional rhetorical devices to indicate the multiplicity of meaning inherent in actuality. Through such structural hints the images and symbols in his writing were fixed along the line established by the movement of actuality into a realm of higher, almost mythic significance.

In another chapter the symbolic world portrayed in Thoreau's work--it is important to note that it is not confined solely to nature--is defined in terms of key actual forms and proportions. In the repetition of these forms and their meanings the scope of Thoreau's higher meaning is formulated. For example, the seasons serve as manifestations for various aspects of man's relationship to the external world, and the stages of a plant's life help to define the internal growth of the individual. The overall meaning pattern indicates rather clearly Thoreau's view of the crucial problem--the challenge of life, the desire to explore an unknown, the need for greater development--which face the individual.

Several of the works themselves--"A Winter Walk," "Slavery in Massachusetts," and Walden--are examined to illustrate how images and symbols interact within a given structure to produce a meaning order of their own. In "A Winter Walk" the cold of winter is presented as a form of fate for man, but its meaning is transformed through the use of symbols and images into a beneficent and instructive trial. "Slavery in Massachusetts" stands as a more dramatic example of Thoreau's attempt to shift actuality from one context of meaning, the political, to his broader spiritual perspective. In the process, which involves a constant distortion of "reality," slavery and freedom become allied with their ultimate sources, the Devil and God. Walden demonstrates the complexities which a longer work, involving a much greater opportunity for

selectivity, entails. Here the flow of meaning is organized by stages which are defined in terms of key symbols. The theme of growth is introduced by fire which represents energy, reaches its first stage in the woodchopper, flowers in the absorption and acceptance of the pond itself, culminates in the seeds of ice, and is inspired anew by the sand flow in spring.

Though Thoreau regarded art as life in the process of becoming meaning, his works were structured according to the patterns of the mind with key symbols standing for key concepts. Through his symbols and images, however, he was able to render his sense of the interaction of the experience and the intellect.

Microfilm \$3.45; Xerox \$12.15. 267 pages.

SWIFT'S ART IN GULLIVER'S TRAVELS

(Order No. 61-3169)

Raymond Joseph Smith, Jr., Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Ricardo Quintana

More descriptive than expository, this dissertation examines the satire, comedy, and irony in Gulliver's Travels, as well as the Utopian element, the latter of which vitally contributes to and is affected by those three modes.

The first two sections, concerned with Swift's satire, attempt to determine the satiric object, point out the satiric pattern, analyze and define specific satiric techniques, and suggest the dominant tone of the satire. The general satiric object is shown to be the rationis capax theme; the satiric pattern is described in its components, which are a satiric background, composed of incidental satire and satiric imagery, a satiric climax, and a satiric norm; satiric methods analyzed and defined are the techniques of disgust, accumulation, concretization, ironic antithesis, parody, and rhetorical climax; and the satiric tone is suggested to be something lighter than saeva indignatio.

The third section, focusing on the comic elements in the Travels, illustrates Swift's use of comic incongruity and discusses the character of Gulliver. Comic incongruity is defined as the sudden intrusion of abnormality in the case of the diminutive Lilliputians and Gulliver in Brobdingnag, the abstracted Laputians, and the equine Houyhnhnms; Gulliver's role as a comic character is shown in the absurd positions in which he is continually exhibited, in his acting as the object of a series of comic discovery scenes, and in such characteristics as his subservience, pedanticism, naiveté, pride, and affectation.

The fourth section, concerned with Swift's irony, discusses its form, function, and complexity. Aspects such as the ironic undercutting of Gulliver's affectation, irony arising from the incongruity, ironic doubleness, and ingénu irony, composed of understatement, irony of simple inversion, ironic ambiguity, and irony of praise-blame inversion, are pointed out, while an analysis is made of the passages describing the Lagodian school of political projectors and the Brobdingnagian treatise on morality to illustrate the complexity of Swift's ironic art.

Finally, in the fifth section, the Utopian passages in Gulliver's Travels are examined, with an attempt being made to define specific Utopian and anti-Utopian elements. These passages are compared and contrasted, and Swift's other writings are brought to bear on the subject whenever feasible. The author's own ideals are shown to be reflected in the concept of equal education for females, in the emphasis on practicality, the legal system of Brobdingnag, and the conversational customs of the Houyhnhnms. Deviations from his ideals are pointed out in the elements of exaggeration, comedy, and rational extremism (exemplified by the Houyhnhnm mistress's stoic resignation upon the death of her mate) that abound in the various Utopian passages. The Struldbrugg incident and Lord Munodi's account of the failure of the Balnibarbian projectors to establish a technological Utopia are shown to be anti-Utopian statements of Swift.

Microfilm \$3.20; Xerox \$11.25. 246 pages.

A POET'S USE OF PHILOSOPHY: A STUDY OF THE RELIGIOUS POETRY OF HENRY VAUGHAN.

(Order No. Mic 61-2067)

Charlotte Jane Stegemann, Ph.D.
University of Pennsylvania, 1961

Supervisor: Allan G. Chester

Henry Vaughan has been variously labelled Neoplatonist, Hermetist, orthodox Christian, Christian Platonist, nature mystic, Christian mystic. The evidence for these labels lies in the imagery of Vaughan's poetry. In other words, the presence of Platonic, Hermetic, or Christian mystic material in Vaughan's images has suggested to his critics the philosophy of the poem and the poet. However, the value of all of the sources to the imagery has been somewhat obscured in the efforts to establish Vaughan as an adherent of one or the other philosophy. Although frequent attempts have been made to acknowledge Vaughan's poetic use of philosophic material, no extensive examination of the poems from this view exists. Accordingly this study is an attempt to evaluate the sources as image-making materials. Of first consideration is the availability of the material. A study of seventeenth-century religion and philosophy indicates an awareness, both directly and indirectly, in the century of Neoplatonism, Christian mysticism, and the general tenets of Hermeticism. Indeed, the controversial character of the age made Platonism in the latter part of the century particularly agreeable. With this background in mind we can more readily comprehend the use of philosophy in Vaughan's images.

In order to determine the function of the images and to interpret them in terms of all of the sources, the poems of Silex Scintillans, Vaughan's major book of religious verse, are considered in the framework of their predominating theme which is also a predominating seventeenth-century theme--the progress of the soul. The steps in this spiritual search move from the external world (which is ultimately rejected in spite of its great virtues of divine revelation and guidance) to the inner world of the

contemplative mind, and finally beyond even the inner world to God. Almost all of Vaughan's poems deal with some aspect of this theme. As for philosophy, the same spiritual search for knowledge of God lies at the root of Plato and Plotinus, of Hermes, of St. Augustine and St. Bonaventura, of Thomas à Kempis, of St. John of the Cross, and of Paracelsus. Consequently, the same symbolic language is serviceable to all aspirants of spiritual truth. Therefore, a chapter is devoted to each step of the spiritual search thereby providing a means of examining Vaughan's images and their sources together.

In spite of the similarities which Neoplatonic or Hermetic or Christian images suggest, Vaughan cannot strictly be called an exponent of any of these philosophies. The intellectuality of the Platonic and Neoplatonic systems suggests a far more disciplined spiritual search from that of Vaughan; the complicated and esoteric search of the Hermetist is only hinted at occasionally in Vaughan; the reality of the mystic's union with God is in Vaughan at most a desire rather than a realization; the very general character of the spirituality of Vaughan's poems weakens the personalization inherent in orthodox Christianity. The sources do not actually contribute a philosophy as such. What they do contribute is intensity. They enrich the images by evoking a whole tradition of the spiritual life rooted in great world philosophies and central to seventeenth-century life. The value of philosophy to the poetry of Henry Vaughan is best appreciated in the awareness of the bulk of material behind the spiritual search rather than in parallel lines drawn from Vaughan and Plato, or Augustine, or Hermes. The most effective images are those in which the strands of Platonism, Neoplatonism, Hermeticism, and Christianity coalesce to emphasize the central theme of the soul's yearning to attain the impalpable eternal truth in the source of all being.

Microfilm \$2.75; Xerox \$8.00. 171 pages.

THE BALLAD IN RELATION TO
EIGHTEENTH-CENTURY CRITICAL THEORY,
1700-1765.

(Order No. Mic 61-492)

John Keith Stewart, Ph.D.
Princeton University, 1953

The purpose of this study is to place critical comments on ballads between 1700 and 1765 in the continuity of eighteenth-century critical theory. Although several early new essays and comments on ballads appear in the process, the particular problem has been to re-examine and rearrange some fairly well-known material against the background of contemporary literary criticism in general. The date of Percy's collection, as the first very extensive one with any considerable literary influence, has been taken as a convenient *terminus ad quem*. Moreover, Percy's practice as a critic and collector conveniently summarizes the practices of a number of those who preceded him, so that in each of the sections of the thesis the technique has been to study the critical theories involved and then their relation to ballad criticism through the time of the *Reliques*.

In general ballad criticism proceeded from two

impulses--historical and critical--which are related in various ways. Its concern with ballads as relics of the national past and examples of linguistic phenomena is part of the antiquarian movement of the seventeenth and eighteenth centuries. There were practical reasons for lawyers and churchmen to be interested in such matters, but it was also felt that "a natural love for one's country" excited a curiosity about antiquities, and it is evident that pride in progress and fear of deterioration, linguistic and otherwise, did too. Critics of the ballad often felt it necessary to shun, or apologize for, their relation with antiquarianism, however, which had the reputation of being an enthusiastic, impolite concern, and preferred to consider their poems a part of history, which was recognized as being different from antiquarian study. In this way ballads could be associated with the virtues of art, and at a time when the traditional comparison of the various arts continued, they could have the benefit of being both history and poetry. Consideration of the ballads themselves from what we call a historical point of view was slow to come, but the comments on them indicate the development of such a point of view.

As either poetry or history ballads were expected to fulfill the requirements of criticism which demanded that art delight or instruct--or both; and they suffered and benefited accordingly. Whatever morality or immorality was found in them, their appeal to the emotions was often conceded, and critics commended them rather early in the century for their qualities of the pathetic and the sublime. On being examined for other virtues, ballads were occasionally sided by contemporary semantic confusions: their obvious general appeal could be taken as an indication that they followed the dictates of Nature; or, paradoxically, on a similar basis one could sanction them for containing what was natural to a particular milieu. The national poetry of countries other than Britain not only offered proof of the universality of Nature's standards, but also bolstered current theories of the original union of the arts and of the poet, musician, historian, and legislator.

In matters of poetic technique the ballad was subject to various considerations, with some possibly significant omissions. Most importantly, numerous attempts were made to place it in the *genres* of the epic and the pastoral--attempts which may have been more to the ultimate advantage of the ballads than of the *genres*, for taking them into the critical fold necessitated lowering the barriers. Little of a positive nature was said about their imagery or meter, but consistently their simplicity was discussed, and here as in their associations with Nature, the various current implications of the word advantageously served those who favored them.

The criticism of ballads in the sixty-five years preceding Percy's *Reliques* shows no clear development within itself of understanding of ballad poetry as such. Throughout the period, however, comments on ballads can be seen to have been made on a conventional basis, and they thus show, aside from the interest in ballads themselves, a number of shifts in contemporary criticism.

Microfilm \$4.25; Xerox \$14.85. 330 pages.

LANGUAGE AND LITERATURE, CLASSICAL

POLITICAL PROPAGANDA IN
CICERO'S ESSAYS, 47-44 B.C.

(Order No. Mic 61-1561)

Rev. Stanley Joseph Adamczyk, S.T.L., Ph.D.
Fordham University, 1961

Mentor: Edward A. Robinson, Ph.D.

The rhetorical and philosophical treatises of Cicero have a double common ground: (1) According to the prologue of *De Divinatione* 2, they were written during Caesar's dictatorship for the instruction of young Roman politicians, and (2) they reflect consistently the political thought of Cicero's *De Re Publica*, both by their pro-senatorial emphasis, and by their bias against any dictatorial, monarchical, and excessively popular tendencies in Roman republican government.

Accordingly, the political elements in the treatises are overwhelmingly pro-senatorial and anti-Caesarian. The pro-senatorial bias of Cicero, especially evident in the *De Divinatione*, the *Tusculans*, the *Brutus*, and the *De Finibus*, is manifested chiefly by: (1) the Roman historical *exempla virtutis* (cf. *Top.* 78); (2) the choice of a senatorial *dramatis personae* for the dialogues (cf. *Senec.* 3); and (3) the politically significant dramatic dates assigned to the dialogues. The regular recurrence of the thought of the *De Re Publica* in the treatises further indicates the pro-senatorial direction of his thinking.

Cicero's anti-Caesarian sentiment, especially manifest in the *Brutus*, the *Tusculans*, the *De Divinatione*, the *De Natura Deorum*, and the *De Finibus*, is seen in: (1) his complaints about the ruinous condition of the republic, the civil war, and Caesar's dictatorship; (2) the unfavorable treatment of Caesar himself and his followers; (3) hostility to the democratic and popular elements of government; and (4) the typical Roman prejudice against kings and tyrants, frequently anti-Caesarian in its implications.

Cicero's purpose to teach young Romans (*locus classicus*, *Div.* 2. 4-5) is evident in all the works of this period. He uses the dialogue form and a teacher-student motif in most of the works, and gives them a predominantly didactic turn, clearly with the idea of making his teaching "exoteric" and intelligible to his students.

In his rhetorical works (esp. *Brutus*, *De Optimo Genere Oratorum*, *Orator*) he is a teacher and critic of true eloquence. That young politicians are the object of this teaching is clear from: (1) the instruction in declamation he was giving to some of them at this time, in order to strengthen his political position (*Fam.* 9. 18. 1-2); (2) the dedication of the aforementioned rhetorical treatises to the young politician-philosopher Brutus; and (3) the Atticist controversy, in which he sought to assert his eminence in political oratory.

In his philosophical works, his main objective is to serve the youth of the nation by expounding Greek philosophy in the Latin language for their moral betterment. Accordingly, he dedicates several of his philosophical works to the young Brutus, gives prominence to young men in some of the dialogues (*De Finibus*, *De Senectute*, *Topica*), and encourages young men to his own broad idea of education, the *ἐγκύκλιος παιδεία* (*De Finibus*, *De Fato*, *Topica*). In addition, he comes forth as a teacher of morals

(*Paradoxa*, *De Finibus*, *Tusculans*, *De Senectute*) and of traditional religion to youth (*De Natura Deorum*, *De Divinatione*). The pro-aristocratic *exempla virtutis* and interlocutors of the dialogues are meant by their *auctoritas* to inspire Roman youth to emulation in learning, virtue, and loyal republicanism. The anti-Caesarian elements, in turn, are meant to show them that Caesar's monarchy was *servitus*, and that only the republic could give them *libertas*, *auctoritas*, and *gloria*.

In addition to the overt political elements in the essays, all of Cicero's *φιλολογώτερα* have a political orientation. Cicero's political ideal embraces eloquence and philosophy. His ideal statesman is the embodiment of the best republican traditions in politics, philosophy, and morality. This broad concept underlies the *De Re Publica*, *De Divinatione* 2, and the entire corpus of his treatises.

Cicero's essays, therefore, were not only a vehicle of his explicit political propaganda to young Romans. They also sought implicitly to create the intellectual, cultural, and moral climate in which the patriotism of young Roman politicians might be inspired to oppose the monarchistic tendencies of the age, and to restore the Roman republic to its pristine glory, under Cicero's personal leadership.

Microfilm \$5.00; Xerox \$17.55. 389 pages.

MARCUS ATILIUS REGULUS:
EXEMPLUM HISTORICUM.

(Order No. 61-3272)

Erving Russell Mix, Ph.D.
University of Pittsburgh, 1961

This study examines the transmission of information and didactic opinion about Regulus, the famous consul of the Roman Republic in the years 267, 256, and 255 B.C. Regulus' place in historiographic works is given a comprehensive survey, from the earliest accounts to those of the present day. A similarly comprehensive treatment might also be made of the various didactic functions which the life of Regulus performed. Here, however, such *exempla* are studied only from Philinus to St. Augustine.

All the factual data for Regulus' life are preserved by no single extant ancient source. As is well known, Polybius is silent about Regulus' peace mission to Rome, his return to Africa, and his death by torture. This silence is at variance with the narratives of most later historians, possibly including Diodorus.

The position is here taken that Polybius' silence about Regulus after his defeat by Xanthippus is to be re-evaluated through a consideration of Polybius' notions about historical causation, his principal source (Philinus), and his aversion to sensationalism. Polybius' silence does not seem valid proof that other, fuller accounts are fictional.

It is from these other accounts, probably of origins contemporary with Regulus, that the more complete biography is to be obtained. One event, the vengeance taken by Regulus' widow after his death, seems to have been effectively suppressed.

Didactic judgments upon Regulus show wide variation of emphasis and motive. Polybius and Diodorus, differing in degree rather than in kind, view him as a tragic character whose arrogance is humbled through the instrumentality

of Fortune's agent, Xanthippus. A tragic note is also sounded in passages of Livy and Boethius.

Among the patriotic Roman evaluations of Regulus and applications thereof, there is a general emphasis upon his poverty, his peace mission, his fulfillment of the oath to return to Africa if the negotiations failed, and his death by tortures variously described.

Cicero portrays Regulus as an ideal Roman living in the ideal Republic. He implies that his own patriotism may be on a par with that of Regulus. From Cicero comes also the portrait of Regulus tortured but not suffering, dying but undaunted.

Pagan writers, from Horace to Claudian, preserve the non-tragic Ciceronian interpretation, but with an occasional expression of rancor against the gods. Often, a fragmentary reminiscence about Regulus serves to illustrate some moral or political proposition. In the cases of Horace and Claudian, the application of the *exemplum* of Regulus to a concern of the moment failed in its didactic intent.

Christian references to Regulus appear as early as Tertullian. These references support the belief that Regulus' gods were defective and unworthy of his noble conduct. Persecuted Christians are exhorted to surpass Regulus in his willingness to die, since they have motives superior to his. St. Augustine finds Regulus admirable for his civic devotion, but denounces his religion and virtue as means of grace or true civic happiness.

To facilitate the examination of the story of Regulus as it survives in later literature and art, this study provides an index to Greek and Latin references up to Suidas. For the same purpose, there is given a list of quotations, from Tuditanus to Suidas, of the variant accounts of Regulus' death. Microfilm \$2.75; Xerox \$5.00. 100 pages.

THE ANNUNTIATIO FESTORUM AND THE PROCLAMATION OF OTHER RELIGIOUS OBSERVANCES IN THE ANCIENT CHURCH

(Order No. Mic 61-1583)

Mother Mary Russo, O.S.U., Ph.D.
Fordham University, 1961

Mentor: Reverend Rudolph Arbesmann, OSA, Ph.D.

The aim of this dissertation has been to examine the custom or rite of the announcement or proclamation of religious observances in general, and in particular of the feasts and fasts, first as a means of unity of worship in the Church of antiquity, i.e., from its beginnings to the eighth century, and then as a semi-liturgical rite which contributed to the solemnity and splendor of an observance in the worship of the Church of later times. Suggested by Reverend Rudolph Arbesmann, OSA, this study is also indebted to F. Cabrol, whose article, "Annonce des fêtes," DACL 1.2.2230-2241, gives the history of the festal announcement from apostolic times to the present on the basis of the evidence from primary sources.

Since the custom is not a Christian innovation, we traced the Christian practice of festal announcements back to its immediate antecedents in the Graeco-Roman world. The testimony of the Greek and Latin inscriptional and

literary sources for the custom is the subject of the discussion in the first chapter, "The Festal Proclamation or Announcement in Pagan Graeco-Roman Religious Practices." Our sources revealed the existence of three significant elements in the pagan custom, whether in oral or epistolary and written form: a specially-designated official empowered to make the announcement, a ritual and a formula.

Since Easter, the most important and oldest of all Christian feasts, has been a movable feast from the very beginning, it had to be announced throughout Christendom to insure its annual celebration on one and the same day. By the close of the second century, it was an established practice that, by means of the letter, the members of the hierarchy conferred with one another and with the patriarchs of Rome and Alexandria to ascertain the paschal date. When this was agreed upon, each bishop, primate or metropolitan communicated the decision to his dependent bishops and priests with the command to circularize his letter throughout the diocese. In the West, the paschal letter remained a simple notification, but in Alexandria, it became an opportunity for exhortation, dogmatic teaching and even polemics. The second chapter, "The Proclamation of the Paschal Date: the Written Festal Announcement," is devoted to an extensive study of the paschal festal announcement in its epistolary form.

By the middle of the fourth century, however, the written festal announcement began to be supplanted by the oral festal proclamation. The third chapter, "The Proclamation of Feasts and Fasts in the Sermons of the Greek and Latin Fathers," treats of the oral festal announcement as it is evident from the *homiliae*, *sermone*s and *tractatus* composed in the period from the fourth to the ninth century. Two principal types of festal announcements are distinguished: the formula-announcement usually made for some movable feast or observance, and the rhetorical or literary festal announcement, occurring most often in relation to fixed or already established observances.

The fourth chapter, "The Proclamation of Feasts and Fasts in the Liturgy of the Latin Rite," deals with the custom as it is found in the second and more abundant source: the liturgy of the Mass, the Divine Office and the Sacraments. The festal announcement in the liturgy for various occasions, e.g., the festal *statio*, the *natalitia* of the martyrs, the ember days, the baptismal scrutinies, was very brief and contained only the essential information of the day and place and the occasion. After the ninth century, the daily reading of the martyrology made the liturgical festal announcement unnecessary and in the twentieth century only one semi-liturgical rite remains: in the pontifical Mass an all-embracing announcement of the movable feasts of the year, is sung after the gospel on the feast of the Epiphany.

The oral festal announcement, whether rhetorical from the sermons or formulary from the liturgy, was enshrined in the antiphons, responsories, hymns and other chants of the prayer of the Church. In the fifth chapter, "The Survival of the Proclamation of Feasts and Fasts in the Hymnology and Chants of the Mass and Divine Office," we tried to show that, though modified and transformed into another shape, the ancient custom of the festal announcement has not been obliterated but perpetuated.

Microfilm \$7.50; Xerox \$26.80. 592 pages.

LANGUAGE AND LITERATURE, LINGUISTICS

**YUSUF WA-ZALĪKHĀ, THE STORY OF
JOSEPH AND ZALIKHA: A COMPREHENSIVE
STUDY OF A HITHERTO UNPUBLISHED
ARABIC SŪFĪ MANUSCRIPT.**

(Order No. 61-3024)

Hirsch Hootkins, Ph.D.
University of Michigan, 1935

The purpose of this study is to trace, as far as possible, the Mystic Islamic Sūfī pertinent statements of the ancient manuscript to Hebrew oral sources. It is an attempt to prove and verify the fact that practically all of these mystic assertions stem merely from the Hebrew oral tradition.

In striving to accomplish the above thesis, all possible Hebrew works were carefully collated. This included the Babylonian Talmud with reference to the subject, the works of the Rabbis dealing therewith, and the seventy-two Midrashim on the subject of Joseph. All these were diligently and painstakingly scrutinized. Then the Greek works of Philo the Stoic and several Latin sources were intensively studied. After all this had been accomplished the old French and Spanish sources were thoroughly investigated. Also used were the many Arabic works of the commentators of the Kor'an, the famous Tafāsīr.

Great and meticulous care was taken to see to it that the old Hebrew sources accepted should, insofar as humanly possible, antedate the birth of Islam.

The results have far exceeded the expectations assumed. All the expressions of the old Arabic manuscript, a hapaxlegomenon apparently, were found to be grounded in Hebrew Oral Lore.

In conclusion, this candidate may venture to state that any Sūfī Mohammedan mystic tenet whatsoever stems, and can only stem, from an original Hebrew Oral Tradition.

Microfilm \$6.85; Xerox \$22.30. 540 pages.

**PATTERNS IN THE LATE EAST MIDLAND
SUBJECT-VERB CLUSTER: A QUANTITATIVE
SYNCHRONIC DESCRIPTION.**

(Order No. 61-3138)

Andrew MacLeish, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Frederic G. Cassidy

This dissertation describes the word-order patterns in the Subject-Verb cluster in certain documents of Late East Midland prose and poetry, 1369-1400. The study is quantitative in that it proposes a methodology for the observation and classification of the frequencies of occurrence of qualitatively defined word-order sequences, and it implies that the description of a process of language change is largely a matter of observing these fluctuations in occurrence-frequency.

The corpus which was examined consists of six prose and six poetic texts. The prose corpus contains Wiclif's *Of Feigned Contemplative Life*, Usk's *Appeal* before the

coroner of London, the anonymous *First Petition to Parliament in English*, and three Chaucerian pieces: *The Treatise on the Astrolabe*, *The Parson's Tale*, and *Melibee*. The six poems are all Chaucerian: *The Book of the Duchess*, *The Knight's Tale*, *Troilus and Criseyde*, Part V, *The General Prologue*, *The Pardoner's Tale*, and *The Nun's Priest's Tale*. Thirteen thousand five hundred and eighty-four clusters were counted and classified.

The aims of the study are fourfold: to describe the word-order norm in the prose Subject-Verb cluster, to describe the ways in which the poetic norm deviates from that of prose, to say something specific about a stage in the development of grammatical order, and to present a detailed set of statistics for each of the twelve works as well as for the total prose and poetic corpora.

The method of approaching the corpus is inductive thus all-inclusive. The study deals with the patterning of subjectivals, auxiliaries, finite verbs, and participles as well as those forms which are contained within the actor-action cluster in pre-verb position in any kind of permutation: accusative objects, dative and periphrastic indirect objects, and adverbials.

Two large divisions of word-order are seen: *common* and *uncommon*. These terms are numerical in their meaning and include a large number of sub-categories. There are two clustering processes in common order: *synthetic* and *analytic*. Analytic order clusters are, of course, most frequent and are thus useful as a statistical base against which every permutation of this order is, at one time or another, measured. Synthetic order clusters are classified as having the verb in end or mid position in the clause and are further described by means of the type of elements, accusative, dative, or adverbial, that are in pre-verb position in simple and compound tense clusters.

Uncommon order clusters lend themselves to a three-part classification in both dependent and independent clusters: *inversions*, *transpositions*, and *inverted-transposed sequences*. Inversions are grouped according to the class of word which precedes them, as they invert by analogy without an introductory element, and by whichever of the three basic patterns they invert into. Transpositions exhibit four patterns with the verb in either end or mid position and inverted-transposed clusters fall into two patterns, both with the verbal form at the head of the sequence.

Eleven charts have been constructed for each of the twelve works and for purposes of summary in the conclusion. These charts show such things as the total numerical and percentual occurrences of types of common and uncommon order clusters, the distribution of adverbial and predicate elements preceding various patterns of inversion, the distribution of patterns of inversion among classes of independent and dependent inversion, the distribution of adverbials and objects in synthetic order patterns, the occurrences of nominal and pronominal subjectivals among common and uncommon order clusters and so forth.

A quantitative glossary of all synthetic and uncommon order clusters is appended to the end of the dissertation.

Microfilm \$5.50; Xerox \$19.60. 432 pages.

LANGUAGE AND LITERATURE, MODERN

AFFIDAVITS OF GENIUS; FRENCH ESSAYS
ON POE FROM FORGUES TO VALÉRY.

(Order No. Mic 61-1310)

Jean Avon Alexander, Ph.D.
University of Washington, 1960

This study was undertaken as a guide to Poe's international influence, with the further intention of suggesting a re-evaluation of Poe's reputation in America. In effect, the study has a double purpose: (1) to present fully a body of evidence not usually available to American students, even in the original French; and (2) to view Poe through the French commentary for the new insight it provides. At the same time, Poe's work, particularly his poetry, has been studied to show the basis for the French admiration and to prove its value.

While the French essays have been selected to give the full scope of criticism from 1846 to 1924, the critical study which precedes them has a more rigorous focus. No attempt has been made to recapitulate studies already made on Poe, either those concerned with his influence on detective fiction and the short story in general, or those concerned with his stylistic influence on late-nineteenth-century verse. Instead, this study begins by clarifying two of the basic motives and conflicts involved in Poe's reception: (1) the conception of the poet's social and moral position in society, and (2) the conception of America as a cultural entity.

These two aspects of Poe's life and work dominated the French criticism in the years between 1846 and 1863, and they were revealed mainly in his prose. Although Baudelaire had admired Poe's poetry and assimilated his poetic theory, asserting poetry's independence from the claims of morality and rationality, in fact Baudelaire had made very little specific comment on Poe's poetry. It remained for the Symbolists to exploit Poe's theories and poetry. Symbolist poets found in Poe's work--not in his theory alone--controlled experiments in a new kind of poetry, essays toward the "supernal" by means of all the intuitive and suggestive powers of imagination without recourse to the methods of reason. Instead of analyzing Poe's poems as captured moments of life or as sensational Romanticism, the Symbolists read them as suggestions or spiritual correspondences.

The combination of these three factors made Poe's influence particularly fruitful, because it not only answered the need for a new poetic approach and a new hero but also provided a way for imagination to use the new scientific tendencies of the age. Without any one of the characteristics, Poe's influence would have been much slighter and briefer, because each characteristic answered to a literary need of the French in the aftermath of Romanticism.

The collection of French essays is not intended to be exhaustive. Some statements about Poe are too brief or too general to warrant inclusion; some repeat the evaluations of authors who write better or are more significant. The collection is therefore a carefully chosen one. Selections were made on a double basis: first, to represent all the attitudes toward Poe from his introduction in France in 1846 to Paul Valéry's essay in 1924 (including comments on poetry, fiction, and nonfiction), and second, to represent the writers who are most important in their own right and in establishing Poe's reputation. The essays in-

cluded are by E. D. Forgues, Charles Baudelaire, Eugène Delacroix, Barbey d'Aurevilly, Louis Etienne, Armand de Pontmartin, Armand Renaud, Charles de Moüy, Arthur Arnould, Gustave Kahn, Stéphane Mallarmé, J. K. Huysmans, Remy de Gourmont, Albert Samain, and Paul Valéry.

Although the essays have been arranged chronologically, they also reveal a trend of evolution or discovery. The earlier essays are concerned with the problems Poe suggested as "pariah" and as American, while the later essays are primarily concerned with Poe's contribution to the new art of poetry. The pattern inevitably asserts itself, even though the essays were chosen to represent all aspects of the French criticism of Poe during the period in which Poe was a creative influence.

Microfilm \$4.80; Xerox \$16.90. 375 pages.

N. A. NEKRASOV, A POET IN
AN AGE OF PROSE.

(Order No. 61-3087)

Sigmund Stanley Birkenmayer, Ph.D.
The University of Wisconsin, 1961

Supervisor: Associate Professor Edmund I. Zawacki

The aim of this study is to provide an objective appraisal of the poetry of N. A. Nekrasov. Since Nekrasov was not only one of the great poets of nineteenth-century Russia but also the publisher of two important literary periodicals, some attention is also paid to his eventful life and his role as the spokesman of certain literary currents and social trends.

Chapter I contains a short biography of Nekrasov, divided into periods as follows:

1. Childhood; The Influence of Nekrasov's Mother on his Spiritual and Intellectual Development
2. School Years
3. University Years; Dreams and Sounds (1840)
4. Journalistic Apprenticeship
5. Friendship with Belinsky; Its Influence on Nekrasov's Development as a Writer
6. Editorship of The Contemporary; Nekrasov as a Businessman and as a Poet
7. Editorship of the Fatherland Notes; The Last Decade of the Poet's Life and Literary Activity.

Chapter II is devoted to a discussion of the themes most frequently occurring in Nekrasov's poetry, which are:

1. His mother and "Mother Russia";
 2. The Russian Peasant;
 3. Criticism of various facets of contemporary Russian society.
- Under each heading, Nekrasov's poems representing a given theme are summarized and discussed, with particular attention paid to the following works (arranged in chronological order):

1. A Knight for an Hour; Excerpts from the Poem "Mother"; Lullaby
2. On the Road; Native Land; A Dog Hunt; Vlas; Reflections at the Grand Entrance; On the Volga;

Peasant Children; The Peddlers; Frost the Red-Nosed; Who is Happy in Russia?

3. Sasha; The Railroad.

A detailed analysis of Nekrasov's poetic art is given in Chapter III, which consists of the following subchapters:

1. Nekrasov's Artistic Evolution as Seen in the Mirror of Russian Criticism
2. Style
3. Metrics.

Within each subchapter (but especially in subchapters 2 and 3), most of the poems previously discussed in Chapter II are analyzed in such a way as to bring into focus the various aspects of Nekrasov's literary craftsmanship. In addition to primary sources (Nekrasov's works in the original Russian), secondary sources (mainly critical studies of him by twentieth-century Russian Soviet specialists) are frequently used in this chapter. It is on the basis of both kinds of sources that Nekrasov's link with his predecessors (Pushkin, Gogol, and Lermontov) is also established.

The conclusion sums up the evidence (furnished by the two preceding chapters, II and III) that Nekrasov was first and foremost a fine lyrical poet and only secondarily a social satirist and an alleged leader of the Russian radicals of the mid-nineteenth century. To quote from the last paragraph of the conclusion, "Writing in an age of prose, Nekrasov faced a dilemma that neither Pushkin nor Lermontov had faced: how to prevent his 'civic conscience' from affecting his poetic integrity. He found a way out of his dilemma by giving, in his poems, an artistic presentation of important social problems of the time."

Microfilm \$7.50; Xerox \$26.55. 590 pages.

VARIETIES OF FORM IN THE
NOVELS OF ANTHONY TROLLOPE

(Order No. 61-3090)

William Edward Cadbury III, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Carl R. Woodring

Close study of representative examples of the fiction of Anthony Trollope shows that he employed throughout his career four quite separate forms of the novel, that these forms are determined not by his progress or development in narrative technique but rather are used in accordance with his aims in constructing particular novels, and that it is therefore critical error to look for a clear development of forms, or for the one essential Trollopian form.

Of the four forms two, the intensive and the panoramic, represent the extremes of Trollope's techniques, and two, the limited and the expanding, use the techniques of the extreme forms to achieve quite different combined forms which fulfill the blending of emphasis on the portrayal of the individual and the broad survey of society which Trollope felt necessary to successful realistic fiction.

The intensive novel is best represented by The

Macdermots of Ballycloran. The form is characterized by a single linear plot, by portrayal of the central character from the inside (with the other members of his society seen as bound by the constricting pressures of society), and by the theme of the opposition of justice and law. The society presented is positively evil, since it stultifies the individual, whose only salvation is in escape. The hero escapes by an act of affirmation of himself, which leads to temporal disaster, but which enables him to maintain his self-respect and is thus victory in disguise.

The panoramic novel, the best example of which is Barchester Towers, has a variety of interlocking plots, with characters seen from the outside as they work out the adaptation which maintains the balance of society, in peril throughout the novel. The theme is politics, through the workings of which the characters adjust their opposing claims. The emphasis is on relationships and interactions, rather than on personal states, and society is seen as good, benevolent if comic.

The limited novel presents a limited world like that of the intensive novel, but achieves breadth by the patterned opposition of two plots. The theme of the limited novel is a variant of the theme of law and justice; in The Belton Estate it is the conflict between social delicacy and personal honesty, and in The Vicar of Bullhampton it is the conflict between Christian charity and the demands of the world. The pattern of the limited novel produces excellent fiction, but was unsatisfactory to Trollope because the narrow scope tends to produce high-powered analyses of low-powered problems.

The expanding novel, good examples of which are Framley Parsonage and Phineas Finn, presents a central character, as in the intensive novel, but shows him moving through a world like that of the panoramic novel, seeking to adapt himself to its demands through the workings of politics, which is the theme. His story touches many others, and as Trollope follows these other plots the novel expands. Whereas in the limited novel the characters must choose between differing sets of values, in the expanding novel, a kind of Victorian picaresque, the hero attempts to manifest both sets of values in action, with differing degrees of success.

These four forms represent the different ways in which Trollope attempted to achieve a balance between the rival needs and claims of the individual and society, and show his different approaches to the problem of how one can live in the world.

Microfilm \$4.35; Xerox \$15.30. 337 pages.

THE SATIRE OF CHARLES CHURCHILL

(Order No. 61-3257)

William Francis Cunningham, Jr., Ph.D.
University of Pittsburgh, 1961

Supervisor: Frederick P. Mayer

During recent years there has been a revival of interest in the poetry of Charles Churchill. The work of J. M. Beatty and James Laver anticipated later studies which culminated in the 1950's with the edition by Douglas Grant, Wallace C. Brown's biography, and Edward Weatherly's

edition of the letters. Fuller study of Churchill's work is necessary and desirable, however, and the present dissertation is a comprehensive view of Churchill and his poetry, and examination of the total body of his production, and an estimate of Churchill's position in the satiric tradition.

A brief consideration of the poet's life and environment reveals his hectic career and presents the background necessary for an understanding of his special kind of satire. A review of his complex reputation manifests a continuous debate over the merits of Churchill's satire, a battle which indeed began in the poet's own era and lasts to the present day. The difficulties in judging Churchill arise from several causes; among them are the problems of Churchill's own personal life and the critics' varying attitudes on the nature of satire itself. Recent apologists of Churchill have been challenged for their praise of the poet as a master of irony. Thus, a re-examination of the satires is profitable, and it is best directed toward the whole body of Churchill's verse.

The materials of Churchill's satires fall into four categories: literary, political, moral, and self-revelatory satires. Although nearly all of the satires contain all four of these elements, the core meaning and activating circumstances of each poem suggest its listing under one of the headings. Only *The Prophecy of Famine*, because of its prominence and divided purpose, is treated in two classifications (literary and political). Of the others, *The Rosciad*, *The Apology*, *The Author*, and *Independence* are literary satires. *An Epistle to William Hogarth* and *The Duellist* are politically-inspired. Those satires which attack some moral incongruity are *The Ghost*, *Gotham*, *The Candidate*, *The Times*, and the *Dedication to the Sermons*. "Self-revelatory" satires are *Night*, *The Conference*, *The Farewell*, and *The Journey*. In this last group, the basic meaning of the poems revolves around the "personality" of Churchill, either of the historical person or of one of the many poses (*personae*) that he chooses to adopt. The "personality" of Churchill appears in various ways throughout all of the verses, as do the literary, political, and moral themes, but the unifying element is sought (often with difficulty) in each satire.

An examination of each poem reveals Churchill as a "foe to restraint," an advocate of the free and the natural as he understands these qualities, in all areas of human activity. His constant battle is against arbitrary and artificial bonds in life and art. He is aware, however, of the general need for order, and he sometimes suggests conservative attitudes. The shifting tones of irony in his works make generalizations difficult. Churchill is best understood in a particular context, and appreciation of his satire depends upon an understanding of his poetic idiom.

Churchill's craft is best studied under the broad headings of irony, structure and versification, imagery and its devices, portraits, and humor. Recent emphasis on Churchill's irony has tended to overshadow other methods utilized by the satirist. Irony is of the essence of Churchill's art, but it is rarely subtle or profound; rather it is close to the surface of life and language and depends upon the interplay of many forces. These elements include his couplet form, invective, "low" diction, parody and other devices. Particularly important are his allusions, portraits, and humor. Churchill frequently gives hints of his ironic attitudes, and he allows the reader to watch his deft handling of idea and phrase. The fullness of his satire

is not easily separated from its local environment, though his best verses rise out of merely local considerations. Churchill's free movement of theme, tone, and style, however, is close to its own dissolution, and sometimes collapses into disorder.

The satire of Churchill is an almost inevitable development in the tradition of Dryden and Pope, and it anticipates the Romantic satire of Byron. Its greatest virtue is its variety of thought and expression. At his worst, Churchill can be entertaining; at his best, he is a significant transitional figure and a satirist of considerable stature in his own right. Microfilm \$2.85; Xerox \$9.90. 220 pages.

GRILLPARZER'S TURN TO THE
HISTORICAL DRAMA: *KÖNIG OTTOKARS
GLÜCK UND ENDE*.

(Order No. 61-3106)

Henry Geitz, Jr., Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Werner Vordtriede

In view of Grillparzer's opinion, expressed in his *Selbstbiographie*, that the historical drama had little to commend it, it is rather surprising that he wrote *König Ottokars Glück und Ende*. This investigation explores the reasons for Grillparzer's hesitation at venturing into a field he considered dangerous, as well as those which, in the final analysis, prompted him to do so.

As a dramatist who always kept the actual performance of a work in mind as he wrote, Grillparzer was at first skeptical of history as a source for dramatic material, for history is epic by nature. That a drama should also be epic is a fault Grillparzer found inexcusable, as evidenced by his opinion of Goethe as a dramatist. Plagued by doubts as to his own abilities, Grillparzer hesitated at the writing of a historical drama. The same force, however, which acted as a deterrent, also served to challenge Grillparzer's artistic sense. Consequently, when he thought of writing historical drama, Grillparzer vacillated between two conflicting emotions, a fear of falling short of his artistic ideal on the one hand, and confidence in his ability to avoid the pitfalls inherent in the form on the other.

The same dualism, fundamental in Grillparzer's personality, is to be seen in his desire for popularity. Vitally interested in gaining and maintaining the favor of his audience, Grillparzer hesitated to risk the popularity he had gained on the basis of his first three works, but in view of the great vogue of the historical drama at the time, he knew he could, with an effective historical drama, gain even greater renown than he then enjoyed.

But undoubtedly the most potent forces in Grillparzer's decision to write *Ottokar* were his intense patriotism and his avid interest in history. That Grillparzer should choose Ottokar as the main figure of his drama is to be explained not so much by any *Napoleonerlebnis* as by Grillparzer's view of history. He looked beyond the mere historical events to the individuals behind those events. He was not as interested in what had happened as he was in why it had occurred, and to show this, the figure of Ottokar had necessarily to become central.

Already in his early attempts at historical drama, Grillparzer had laid primary stress on an incisive psychological observation of his characters. In *Blanka von Kastilien*, for which Schiller's *Don Carlos* was the model, there is a pronounced shift of emphasis. While Schiller had stressed the idea of freedom, both political and intellectual, Grillparzer stressed the emotions. The love of Fedriko and Blanka and the almost maniacal lust for power on the part of Rodrigo and Maria de Padilla are the axis about which everything revolves.

This same emphasis on the psychological is evident in *Ottokar*. Grillparzer dissects his characters, as it were, and by a single word or movement bares the innermost thoughts of a figure. Thus, Grillparzer points the way to the modern era.

Fully conscious of the weight of Austrian tradition, Grillparzer simultaneously surrounds his work with an aura of the Baroque, both in idea and in style. Already in the title of the drama is seen the *vanitas vanitatum* which preoccupied the poets of the seventeenth century. Thus, Hofmannsthal's appraisal of Grillparzer as a bridge between the spirit of the old Austria and that of the new is completely justified.

The influence *Ottokar* exerted on the historical drama which came after it is quite limited. This is unfortunate, for in *König Ottokars Glück und Ende*, Grillparzer has achieved a synthesis of form and content which make the work a high point in the German historical drama.

Microfilm \$2.75; Xerox \$9.00. 197 pages.

K. A. VARNHAGEN VON ENSE:
MAN OF LETTERS, 1833-1858.

(Order No. 61-3107)

Philip Fredric Glander, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Werner Vordtriede

K. A. Varnhagen von Ense (1785-1858) is the outstanding diarist and memoirist in German literature, yet he is a figure little known and generally discredited. His close association with literary circles from Romanticism to the middle of the century and the copious notes he left on his literary friendships have made him ubiquitous in German literary history. The opinion of generations who followed him, to whom Varnhagen was largely a scandal-monger, has determined his reputation for the latter half of the nineteenth century and well into our own time.

This study is an attempt to re-examine Varnhagen's role in German letters and to re-evaluate his service to literature. His relationships with the major figures of the day are examined closely, and the resulting picture of Varnhagen, it is hoped, will help rectify the prevalent notion of him. His political theories and the influence of his wife, Rahel Levin, are only touched on here. The investigation is directed towards his last twenty-five years when he was living in Berlin, after Rahel's death, as a renowned critic and biographer.

In some instances his association with certain writers is so important that the limits set elsewhere are extended to give a complete picture. Thus Varnhagen's friendship

with Goethe, which began in 1811, is recounted in detail. A complete record of their correspondence and visits introduces a recapitulation of Varnhagen's work in defense of Goethe's controversial later works. Varnhagen based his life on a reverence for Goethe, and as "Statthalter Goethes auf Erden" his association with other figures in literature follows. Heinrich Heine was closest to Varnhagen during the decade 1821 to 1831. Varnhagen's influence on Heine is examined for this period and after Heine's removal to Paris as well. Attention is paid to the introduction of the Varnhagens to Saint Simonism by Albert Brisbane, the American socialist. In the latter half of the 1830's Varnhagen was closely associated with the authors of the *Jungdeutschland* movement in Berlin. He served as a patron to Mundt and Laube and was close for a time to Gutzkow and to lesser figures in the movement. His most important contribution was helping Mundt and Laube become established journalists. Varnhagen was also well-known outside of Germany. His home in Berlin was for years a meeting-place for foreign visitors, and he carried on extensive correspondences with men of note in England, France, the United States, and Russia. Particular attention is paid to his English friends who include Thomas Carlyle, George Lewes, George Eliot, and Richard Monckton Milnes. French, American, and Russian friends are discussed elsewhere or else omitted from consideration for want of available information. Figures from literary circles in Berlin were also associated closely with Varnhagen. The major names in this group are Gottfried Keller and Bettina von Arnim. Keller knew Varnhagen during his stay in Berlin from 1850 to 1855, and Bettina was close to Varnhagen for the entire period of her creative life. The reliability of Varnhagen's reports about her and the Brentano-Arnim family is a controversial point in literary research. Other figures whose names occur in nineteenth-century German literature are included here. These include Fanny Lewald and Adolf Stahr, Herwegh, Hartmann, and Freiligrath.

Since Varnhagen's friendship with the persons mentioned above is recounted here for the first time in most instances, much of the work is directed towards presenting an accurate and complete record of the relationship involved. The material presented here has been assembled from numerous widely-scattered sources in the hope that it will place Varnhagen in a new light. He deserves greater prominence for his work as an essayist, biographer, and critic, and especially for his work as a diarist and writer of memoirs for which he remains unique.

Microfilm \$2.75; Xerox \$9.45. 208 pages.

MICHELET ET L'HISTOIRE ALLEMANDE.
[French Text.] (PARTS 1 AND 2).

(Order No. Mic 61-990)

Oscar A. Haac, Ph.D.
Yale University, 1948

In his *Histoire de France* and other works, Michelet left abundant descriptions of Germany. We study them as an expression of the germanophile attitude; they reflect the intellectual stimulation Germany exerted on France; we examine them also as a significant segment of historical

writing which enables us to define his method and his philosophy.

The commentary extends from the Cimbers and Teutons opposing Marius to the sequel of the war of 1870 when, at first horrified by the rise of German nationalism, Michelet once more forgave and magnanimously expressed sympathy. We study the narrative in seven main periods. They include the critical eras he examined repeatedly, medieval Germany, Luther's Reformation, and the national revival in the early nineteenth century. The contrast between successive interpretations illustrates the historian's development toward an ever more resolute democratic idealism. Our analysis clarifies not only his image of Germany but the growth of his philosophy of history.

After defining Michelet's basic orientation, the debt of gratitude he felt toward German culture and science, we describe, for each of the seven periods, first his account of historical events, then his comments on the authors and artists of the period. It is one of Michelet's great contributions to historiography to have merged cultural, social, and political history. We have identified over six hundred authors and artists and listed them again in an appendix which, along with one hundred pages of critical bibliography, will, we hope, prepare the way for the long overdue critical edition of his works. The Germans he cites, often in vague references, include historians, literary figures, mystics and philosophers, artists and musicians, scientists in all fields. It is interesting to note how little he speaks of romantic and post-romantic literature, and how many German sources he consulted in the fields of geography and physiology. Even with its omissions and within the limits of Michelet's knowledge of the language, his admiration was based on voluminous readings and many-sided interests.

Michelet's view of Germany was crucial to his conception of history. It was highly personal. As he himself stated, his history was never impartial. He intended to defend the cause of freedom. Only the clear analysis of these aspects can explain Michelet's changing interpretation and, in turn, furnish the key to his philosophy, his growing faith in the principles of the French Revolution, his increasing opposition to tyrants and Napoleon. We have further clarified these concepts in our study, *Les Principes Inspirateurs de Michelet* (Paris and New Haven, Conn., 1951), 242 pp.

Michelet's admiration for Germany did not limit his love of France. As a cosmopolitan patriot, he worshipped France as the incarnation of liberty and Germany as a cultural center of the modern world. Germany's role was to define, by contrast, the free and rational tradition of France, a rationalism defended by Michelet with the fervor of religious conviction.

Microfilm \$6.95; Xerox \$24.75. 547 pages.

THE NOVELS OF JOHN COWPER POWYS

(Order No. Mic 61-708)

Christian Blanchard Hewitt, Ph.D.
Boston University Graduate School, 1961

Major Professor: Doris Holmes

Powys's criteria for what constitutes a good novel -- intense reality in characters and background, and intense interest in what happens next -- are the basis for this analysis and evaluation. Admittedly vague, the criteria had to be clarified, explored and related to other aspects of the novel.

If some measure of a novelist's greatness lies in his vision of humanity, in the number and variety of people who inhabit his world, the sympathy and understanding with which he views them and the range of incidents they move in, Powys must be rated high. The scope of Powys's portrayals, deep and wide, includes all social levels, the young, old, simple, complex. To find a comparable gallery of women one must turn to the great masters of feminine portraiture. Many characters, both men and women, inhabit the loftier regions of the imagination. Without losing the unique humor of each living person he imparts a sense of the motley assemblage of humanity in general.

Much that occupies people from sun-up to sun-down is missing. Emphasis is not on outward events so much as on the individual's passage through them. Powys catches the "real reality" of people through the concentrated angles of vision of their erotic life and their view of Eternity. His own vision is permeated by a profound sympathy with the idea of the Eternal Feminine itself and an immense pity and understanding of all humanity as wayfarers and outcasts.

The "real reality" of the background is evoked primarily through Nature, the mysterious, and the past. Through a complex interweaving of Nature with character and action, Nature becomes a key to a deeper insight into man. The out-of-doors is incomparably conveyed and with it a sense of the mysterious, for Powys's view is animistic: in each thing, animate or inanimate, resides a "feeling power" capable of affecting all else. Subtle combinations of psychic and chemical energies, sometimes supernatural, frequently influence human behavior, one of Powys's major premises being that intense thought or feeling generates psychic energy not immediately dissipated. A sense of the past too lies everywhere, overwhelmingly in myth and legend. Always the memories of living men stretch back, through the near past, whose tap-root lies in village life, into some mysterious pool of ultimate experience.

As a story-teller Powys's most effective instrument is his power to realize individual scenes, covering a wide range of events and emotions. Realising that the high moments of drama require audacious means, he uses them. He can rise to a great occasion. Though he is capable of utilizing dramatic tensions gradually built up through innumerable associations, scenes are often felt to be isolated. The panoramic scope of his novels, the continuous flow of a character's sensations, arbitrary insertions of Powys's own interests -- all obstruct dramatic movement. Absorption in character apart from thematic structure results sometimes in dramatic discontinuity and disproportion. Nevertheless Powys does weave together a subtle

complex of themes and actions, helped by a style that is marvelously flexible -- simple and direct as well as magniloquent.

The dominant theme is that there are no final answers. Whether in the name of the Father or the Future, inviolable tenets are the breeding ground of fanaticism and cruelty. Man's problem is to reconcile his happiness with the cruelty inherent in Nature itself.

The paucity of critical comment on Powys's novels, considering the beauty, range and depth of his five great novels alone -- *Wolf Solent*, *A Glastonbury Romance*, *Weymouth Sands*, *Owen Glendower* and *Porius* -- is undeserved. He has long been undervalued.

Microfilm \$3.80; Xerox \$13.30. 294 pages.

THE EPIC INTENT AND THE AMERICAN DREAM: THE WESTERING THEME IN MODERN AMERICAN NARRATIVE POETRY.

(Order No. Mic 61-2660)

Arthur Murray Kay, Ph.D.
Columbia University, 1961

Although it is generally conceded that the traditional epic form is no longer feasible, the epic intent has persisted in American poetry. A number of modern poets, most writing in an era and spirit of "rediscovery," have found epic material in America's "usable past" -- specifically in the exploration and settlement of the continent.

The acclaim given to *John Brown's Body* and *Conquistador* expressed a general desire for some kind of great modern epic. Since their appearance, in 1928 and 1932, some two dozen long narrative poems were published, most of which show explicitly and implicitly the intention to emulate the famous epics of tradition. Taken as a group and arranged according to the historic sequence of their subjects, they form a modern epic cycle on the theme of westering, the energetic, conative impulse which characterized America's discovery and the subsequent phases of her development.

Henry Chapin's *Leifsaga* (1934) and Winfield Townley Scott's *The Dark Sister* (1958) describe the Norse adventure in Vineland. Benét's *Western Star* (1943), first part of a projected epic, treats the settlement of Plymouth and Jamestown, while Mark Van Doren's *Jonathan Gentry* (1931) traces the succeeding westering phase to the Northwest Territory. The trek across the desert is recounted in "covered wagon" epics like Frank Ernest Hill's *The Westward Star* (1934), Helene Magaret's *The Great Horse* (1937), or Chapin's *West Walking Yankee* (1940). John Neihardt's *Cycle of the West* depicts in six narratives the legendary mountain men and the subjugation of the Indian.

What rescues these poems from the ranks of hollow patriotism is the emergence of a darker strain, a pessimistic counter-theme to the glorification of history: escape from oppression and corruption, valiant questing for a clean start in a brave new world-- these are doomed or possible of only partial fulfillment, since men, being men, carry with them the seeds of evil; thus America has fallen tragically short of her early promise. In this respect, the modern epics move in the mainstream of protest.

Their conventional symbol of that evil is Gold, which

distracts pioneers from nobler tasks, breeds dissension, lust, and hatred. Several poems deal directly with the ugliest aspects of the Gold Rush, but most use gold greed to imply the opposition-- in broader terms-- of exploitation and soul-destroying commercialism to the agrarian ideal of a Jeffersonian Democracy.

The tone of the poems vary according to the proportionate stress on sanguine theme or pessimistic counter-theme. Susan Mitchell's poem on Columbus reflects the hopefulness of Barlow's *Columbiad*, while Edgar Lee Masters' *The Golden Fleece of California* (1936) and *The New World* (1937) are at the bitter extreme of populist disillusionment. Donald Davidson's *The Tall Men* (1938) and John Gould Fletcher's *Story of Arkansas* (1941) mourn the demise of the last stronghold of pioneer and yeoman virtues, the South. Leonard Bacon's mordant satire, *Lost Buffalo* (1930) portrays the ruin of the nobly savage Indian by white civilization and whiskey. Both *Jonathan Gentry* and *John Brown's Body* strike a balance, tempering nostalgia and disillusionment with a realistic acceptance of an inevitable historical and economical process.

There is little really distinguished poetry-- as poetry-- in the cycle. The best poems-- e.g. *Conquistador*, *John Brown's Body*, *The Dark Sister*, *The Tall Men*-- show originality and craft, but the general range of quality is from bare mediocrity to competence. While MacLeish puts to good use techniques learned from Pound and other modern originals, John Neihardt, though endowed with narrative skill and descriptive power, suffers from enslavement to outmoded form and diction. Others buckle under the strain of sustaining poetry over a long narrative. A few gain nothing at all by using verse, unless it be through the formal association with traditional epic.

These efforts are by no means as absurd as the strivings of Barlow and Dwight to produce epics. But primarily the westering epics are of cultural or historical interest. They hoped to appeal to the great audiences Whitman called for. They aspired to mythopoeia, to create an American type of hero shaped by the conditions of the wilderness. They celebrated the achievements of common men. They reflected the wistful delving into the national past so characteristic of their era. Their subjects often paralleled the interests of Frederick Jackson Turner's school of thought. Perhaps the westering cycle can be best understood as the working out of the dialectic traced by Henry Nash Smith in *Virgin Land: The American West as Symbol and Myth*-- the pursuit of a great ideal, and its failure.

Microfilm \$4.55; Xerox \$16.00. 354 pages.

HAWTHORNE'S USE OF PAGEANTRY

(Order No. 61-3130)

Charles Loyal Leavitt, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Harry Hayden Clark

Hawthorne's use of pageantry, especially concerned with theatre, is aptly keynoted by what he acknowledged late in life as "the mysterious glory that has surrounded theatrical representation ever since my childhood." Life

being a "drama, in which we are involuntary actors," Hawthorne suggests that a romancer must create "a theatre a little removed from the highway of ordinary travel."

Familiar with Shakespeare, as well as the Gothic, melodramatic, and sentimental drama of his own day, Hawthorne uses such techniques as soliloquies, asides, dramatic entrances and exits, and dramatic recognition scenes. Phoebe accuses Holgrave of being "too cold-hearted" a "spectator" of Hepzibah's dilemma. Many references are to "audiences," "applause," "shows," "pictures," "showman," "showbox," diorama, and panorama. Scenery is generally visualized through the picture-frame proscenium arch of the theatre, comparable to a picture-window. The word "scene" with dramatic context is employed over three hundred and fifty-five times in Hawthorne's works. Miriam's cynical remark concerning "the illusive stage scenery amid which we tread" philosophically and symbolically suggests the theatre world. Using a variety of stage effect, Hawthorne skillfully handles "atmospherical medium," causing the "showman," in "Main Street," to suggest the principle of theatrical chiaroscuro to his "audience": "...by my control over light and darkness, I cause the dark, and then the starless night, to brood over the street..." Hawthorne uses variety in theatrical types, including stage villain, comics of caricature and farce, sentimental characters, and the "unknown" modeled on types common in Shakespeare, Scott, and Gothic writings.

Hawthorne's point of view is like that of a man sitting in a theatre focusing his attention on an imaginary space occupied by the stage proscenium arch. Thus he establishes his first person singular viewpoint and evaluates what passes in front of him. Coverdale views Zenobia and Westervelt from his concealed bower in a tree. Windows, resembling the theatre proscenium arch, assume significance as characters gaze at suitably framed dramatic action: through the Boston boarding-house window, Coverdale observes Zenobia and her companions.

Masquerading characters in "The Maypole of Merry Mount," "Howe's Masquerade," "My Kinsman, Major Molineux," *The Blithedale Romance*, and *The Marble Faun* not only add pageantry, but also suggest various levels of characterization, introspection, and symbolism. Wide varieties of static and dynamic tableaux enhance dramatic situations and characterizations, such as Ibrahim between his mother and Dorothy, and Zenobia at Pulpit Rock. *Tableaux vivants* are organic and integral, suggesting the general cultural level of various Blithedale groups.

Hawthorne's processions present a kaleidoscopic picture of a number of scenes and characters, without the necessity of his stopping for extended character analysis: "the funeral procession of royal authority in New England" formed in "Howe's Masquerade"; military processions; religious processions; the festive "procession of the Senator" during the Carnival in *The Marble Faun*; the political torchlight procession in *The House of the Seven Gables*; and processions composed of organized groups of personages, as in "The Procession of Life."

Minor aspects of pageantry are documented under these categories: spectacle, public celebrations, specious show, symbolic tapestries, rituals, and pomp. Over three hundred mirrors in diverse ways heighten Hawthorne's pageant effects.

Hawthorne's use of pageantry allows him to achieve four literary aims: to present symbolism with the abstract

bodied forth concretely through masque-like detail; to create harmony of mood and unity of impression through the "atmospherical medium"; to further his specialized type of romance by interplay of light and shade; and, to allow, by contrast between pageantry and photographic realism, freedom for a degree of fantasy, whimsicality, or the light poetic touch which invoke his kind of romance: a world halfway between faeryland and reality.

Microfilm \$12.80; Xerox \$45.70. 1016 pages.

THE COMMON SEAMAN IN NINETEENTH CENTURY AMERICAN FICTION

(Order No. Mic 61-1103)

Charlotte Holt Lindgren, Ph.D.
Boston University Graduate School, 1961

Major Professor: Gerald W. Brace

The role of the common seaman in nineteenth century American fiction is a revelation of the interest in the common man, the growth of democracy, the agitation for humanitarian reform, and the quest for nationalism which characterized the new nation between 1790 and 1865. The fictional seamen not only represent the actual men who shared the crowded quarters of the forecabin, but perhaps they are also a manifestation of the spirit of American democracy and the development of a native mythos. The sea has always been basic to American life and thought. In the opening years of the century, trade with the Orient was highly profitable. American whalers explored the islands of the Pacific and became familiar with the watery wastes from the Arctic to the Antarctic. With the establishment of a strong Navy following the War of 1812, America became one of the great maritime powers of the world. Later in the century when the frontier lured young men of adventure away from the sea and foreign crews filled the forecabin of ships, conditions on board American vessels worsened. Harsh treatment, bad food, long hours, and low pay discouraged men of ability from a maritime career. Yet there were always men who grew restless on land and, like Melville, returned to the sea.

It was a piece of extraordinary good fortune that the forecabin of American ships contained three such eloquent spokesmen as James Fenimore Cooper, Richard Henry Dana, Jr., and Herman Melville. The fiction written by these men reflect their own experiences at sea. Cooper sailed in the early days of the century when a young man of ability could begin at the bottom and rise to the quarterdeck. Captains felt a paternal interest in their crews, and men were loyal to their ships. Dana represented the gentlemen of good family who sailed before the mast to restore their health and see life firsthand. A lawyer in later years, he fought to bring about legal reforms for the betterment of seamen. Herman Melville served in every maritime branch--merchantman, whaler, and frigate--in the later years when captains were tyrannical and the crew represented the outcasts of all nations. He saw in their problems not only the need for maritime reform but the universal suffering of all mankind. Of course, there were romantic novels of the sea. Henry Cheever, Edward Judson, and Captain Ingraham wrote of noble young tars

and wicked villains, but to counterbalance these popular tales were the factual narratives of genuine seamen-- Nathaniel Ames, Amasa Delano, J. Ross Browne, and Josiah Cobb.

Although English writers had already popularized maritime literature, America's unique contribution was the development of seamen such as Long Tom Coffin who, like Jonathan, the Yankee farmer, and Leather-Stocking, the frontiersman, represented a stock figure. Except for the legend of Captain Kidd and the tales of pirates who buried treasure or smuggled along the Atlantic coast, America had little folklore, but her writers created a feeling of mythos through the use of allegory and symbolism. The seaman hero of American fiction was based on fact, but he also was representative of the democratic individual freed from the stultifying restrictions of civilization. Closer to the sea than the land, he was part of the American dream which visualized the typical American as solitary, courageous, ingenious, and kin to the natural elements.

The invention of steam-driven vessels and the advent of the Civil War brought the age of sail to an end. New legislation and shorter voyages improved conditions for the common seamen. The "old salt" like the pioneer became part of America's heritage.

Microfilm \$3.60; Xerox \$12.60. 277 pages.

OBJECTIVITY AND CHANGE IN
PARDO BAZÁN'S TREATMENT OF PRIESTS,
AGNOSTICS, PROTESTANTS AND JEWS.

(Order No. 61-2922)

Edward Fletcher McLean, Ph.D.
Duke University, 1961

Supervisor: Gifford Davis

This thesis is an analytical study of Emilia Pardo Bazán's treatment of priests, agnostics, Protestants and Jews. Its purpose is to determine the objectivity of the author in treating these groups. To comprehend this objectivity, it has been felt necessary to attempt to understand the enigma of her Catholic practice and her acceptance of French naturalism. This study involves a treatment of sixteen of Pardo Bazán's novels which were written over a period of thirty-two years. Information has also been taken from her *Teatro Crítico* and other critical works.

Because of the area of her interest, her treatment of priests is more extensive than that of the other groups. The study follows the divisions into which Pardo Bazán's novels have been grouped, making it possible to pursue systematically her treatment of priests from her beginning as a neo-Catholic through her naturalistic, idealistic, and symbolistic periods. More attention has been given the regionalistic novels, since these novels are more pertinent to her treatment of priests. In arriving at an evaluation of her treatment, an analytical and synthetic study is made of the individual priests appearing in the novels of each period.

The same procedure has been applied to her treatment of agnostics, in regard to whom an attempt has been made

to show the change which is obvious in Pardo Bazán's presentation. Treating them amiably from their first appearance, throughout her novels she progressively presents them as superior in intellect and character. Attention has been given to her selection, proving her to have preferred agnostics to Protestants and Jews. The benignity of her treatment of agnostics is explained in the light of her close ties with intellectuals whom she respected and admired in spite of their incredulity.

The author wrote sparingly of Protestants and Jews, presenting them only in one of her naturalistic novels, *La Tribuna*, and in her idealistic and symbolistic periods. Their treatment, while of secondary importance, does accentuate, however, the inability of Pardo Bazán to free herself from inherent prejudices.

The place occupied by Pardo Bazán in nineteenth-century literary Spain was unique in that while recognized as a staunch Catholic she embraced the naturalistic technique of writing novels. In accepting Zola as her teacher, she was not only breaking with Spanish literary tradition but was allying herself with an atheistic school of thought. An attempt is made to explain this enigma by considering Pardo Bazán's interest in philosophy, peninsular and foreign literary genres, her travels, and in short, her cosmopolitanism.

In order to discuss intelligently the peculiar position occupied by the Countess, the first chapter of this thesis has been devoted to a collection of biographical data and to the attacks launched against her by her contemporary writers and critics. In the conclusions, an attempt has been made to invalidate the harsh criticism which was often outbursts of prejudice rather than sound critical analysis.

While her critics accuse Pardo Bazán of being a weather vane and of dabbling in all literary genres, her trajectory, as followed in this study, proves her to have been generally consistent and objective throughout her life.

Microfilm \$3.60; Xerox \$12.60. 277 pages.

THE INTERNATIONAL THEME IN THE
NOVELS OF TURGENEV AND HENRY JAMES

(Order No. Mic 60-6307)

Anthony Matthew Mlikotin, Ph.D.
Indiana University, 1960

The study of the internationalism of Henry James has been abundant and searching; the study of the Westernism of Turgenev has been on a lower and more polemical level. The comparative approach makes one author benefit by the methods developed for the other.

To gain some biographical cues, the investigation begins with a tentative analysis of parallel periods in the "international lives" of the two authors. Their education, their studies abroad, their travels, and their final settlement in a foreign land are examined in regard to the development of their cosmopolitan views. The impact of their experiences on their art is outlined.

The analysis of the international elements in Turgenev's novels *A Nobleman's Nest*, *On the Eve*, *Smoke* in ch. II precedes ch. III only chronologically; logically it is patterned after ch. III, where the internationalism of *The*

American, The Portrait of a Lady, The Ambassadors is recorded on the basis of scholarly studies which are more sophisticated than in the case of Turgenev's novels. In Henry James we find them more abundantly, and only in his novels does the motivation itself become international. There are many differences in degree in all six novels, but only those of Henry James are essentially international, those of Turgenev are incidentally so.

Ch. IV starts out from the well-known influence of Turgenev on James in subject matter and minor techniques, lists the similarities in the three pairs of novels, articulates the quantitative differences that made themselves felt in the comparison and, in continual argument with recent Soviet and American critics, underlines the qualitative difference of the internationalism of the two authors. The international theme occupies a very minor place beside the Russian themes of Turgenev, it is only a side line in some of his novels. In some major novels of Henry James it penetrates the essence and the structure.

Microfilm \$2.75; Xerox \$8.20. 178 pages.

RAFAEL POMBO, VIDA Y OBRAS.

[Spanish Text.]

(VOLUMES I AND II).

(Order No. 61-3181)

Héctor Hugo Orjuela, Ph.D.

University of Kansas, 1960

The present thesis is a study of the life and works of Rafael Pombo, the most distinguished Colombian romantic poet. Besides a complete biography and an extensive bibliography compiled in foreign as well as in United States libraries, it contains several chapters leading with the various aspects of his poetry and his literary role during the romantic period. The last chapter is devoted to his prose works.

Since up to this date no biography of Rafael Pombo has been written and only minor works have been attempted on his poetry, this thesis aims to present a complete study of the poet who is undoubtedly one of the most outstanding literary figures in Latin America during the 19th century. The main purpose of the work is to re-evaluate the importance of Rafael Pombo in the history of the romantic movement in the Hispanic world and in the field of Colombian letters.

Microfilm \$5.30; Xerox \$18.90. 416 pages.

LA LITHUANIE DANS L'OEUVRE DE

O. V. DE L. MILOSZ

[French Text.]

(Order No. Mic 61-2615)

Aldona Slepetyš, Ph.D.

New York University, 1958

Adviser: Germaine Brée

Oscar Vladislav de Lubisz Miłosz (1877-1939), Lithuanian by birth, lived in Paris from the age of twelve, and wrote his work in French. Besides his poetic, mystical and philosophical works, his writings on political, historical and philological subjects, and on folklore, he made many translations of foreign authors.

Especially since the death of Miłosz in 1939, his stature in the literary world has been growing all the time. An important body of criticism pays tribute to the ever increasing importance of his work.

While the critics do not all see the work of Miłosz in the same light, and hold varying opinions on certain aspects of his work, especially the mystical side, they all agree as to the artistic value and profundity of his work, the perfection and purity of his style. Today he is sometimes compared with Pascal, Baudelaire, Edgar Poe, Claudel, or Francis Jammes. However, if some more or less superficial affinities with these writers are to be found, Miłosz has his own creative genius which belongs to him alone.

The object of this dissertation is not to study the work of Miłosz as a whole. We propose to illuminate the lesser known of his writings, which up to the present time have hardly been touched upon or even mentioned: i.e. the works specially devoted to Lithuania and Lithuanian subjects which are assembled in volumes V and VI of his *Oeuvres Complètes* (Ed. L.U.F., Egloff, Fribourg) and will also appear in volumes VI and IX in the forthcoming edition of his complete works by La Librairie Les Lettres (Paris). We also propose to survey his relations with his native country and its influence on his work; to discover further details which will give a better knowledge of his personality and thereby throw a more penetrating light on his work.

The plan of this dissertation is as follows:

INTRODUCTION: a) Importance of the work of Miłosz.

b) Presentation of his work as a whole.

c) Reasons why Miłosz did not receive earlier recognition.

d) His influence.

e) Critics and the work of Miłosz.

f) Aims of this dissertation.

CHAPTER I: The childhood of Miłosz in his native land and its influence on his poetry:

a) The family home, environment,
nature.

b) His poetical work.

CHAPTER II: Les Origines de la Nation lithuanienne and
other works on Lithuanian subjects.

CHAPTER III: Contes et Fabliaux de la vieille Lithuanie
and Contes lithuaniens de ma
Mère l'Oye.

CHAPTER IV: Dainos, ancient folksongs of Lithuania.

CONCLUSION

BIBLIOGRAPHY

In the trials and experiences of his early childhood
and the days spent in his native land is to be found, in
part, the key to understanding the work of the great poet

Milosz. These memories have left the most vivid impressions on his mind; from the very beginning, a large part of his work is strongly influenced by them, they become the leit-motif of his poems. He invests these memories with a symbolic, mystical aspect, transfiguring reality, which we have tried to trace gradually in the first chapter.

In Chapter II, we describe the poet's remarkable activity in the movement for the resurrection of Lithuania and during its independence as Ambassador, his numerous writings during this period and his personal researches on the origins of the Lithuanian people.

Milosz's interest in the past history of Lithuania and profound love for his native country led him to take particular interest in Lithuanian folklore which he wished to make known to a wider public. In Chapters III and IV we undertake an analysis of Lithuanian tales and songs which have been brilliantly recreated by the poet, keeping all the simplicity, freshness, grace and sonority of the original works. He has brought out the characteristic beauty of the tales and verses while preserving as carefully as possible all their rhythmic variations.

Even in his most abstract thoughts, Milosz is a poet in the full sense of the word. His work extends into practically every domain of thought; but in whatever domain, Milosz transcends as a great poet.

Microfilm \$2.75; Xerox \$9.25. 204 pages.

MATHEMATICS

RANDOMIZED ESTIMATES IN POWER SPECTRAL ANALYSIS

(Order No. 61-2913)

Willard Osborne Ash, Ph.D.
Virginia Polytechnic Institute, 1958

This study has been concerned specifically with the problem of estimating the power spectrum associated with a random process. It has shown how the power spectral density function $\phi(\omega)$ can be used to specify completely a stationary Gaussian process. Estimation of this function is therefore one of the fundamental problems in random time-series. The power spectral density function is given by

$$\phi(\omega) = \frac{2}{\pi} \int_0^{+\infty} \rho(\tau) \cos \omega \tau \, d\tau$$

and must be estimated from a partial realization of the process. To accomplish this, the usual procedure is to use estimated auto-covariance functions $\hat{\rho}(\tau)_A$ computed from a set of observations $X(t_i)$ from which $\phi(\omega)$ is approximated by numerical integration. This gives

$$\hat{\phi}(\omega) = \frac{1}{W} \left[\hat{\rho}(0) + 2 \sum_{j=1}^{m-1} \hat{\rho} \left[\frac{j\pi}{W} \right] \cos \frac{\omega j\pi}{W} + \hat{\rho} \left[\frac{m\pi}{W} \right] \cos \frac{\omega m\pi}{W} \right]$$

where the $\hat{\rho} \left[\frac{j\pi}{W} \right]$'s are estimated from

$$\hat{\rho} \left[\frac{j\pi}{W} \right] = \frac{1}{n} \sum_{i=1}^n X(t_i) X(t_i + \frac{j\pi}{W}) \quad j = 0, 1, \dots, m.$$

$\hat{\phi}(\omega_a)$ is widely used in power spectral analysis and although it can be shown to be biased, the side lobes of its spectral window can be smoothed in such a way that the bias is greatly reduced. The difficulty with the estimator is not so much with its bias, but rather with the considerable numerical task it creates even when digital computing equipment is available.

The primary objective of this research was to devise an estimator which would simulate the bias of the classical estimator $\hat{\phi}(\omega_a)$ but which would require much less work to compute. To this end the randomized estimator

$$\phi^*(\omega_a) = \frac{1}{n} \sum_{i=1}^n X(t_i) X(t_i + k_i \Delta t) G_a(k_i)$$

was considered. Unlike $\hat{\phi}(\omega_a)$ which was constructed by systematically forming all possible lagged products $X(t_i)X(t_i + k\Delta t)$, $i=1, 2, \dots, n$ and $k=0, 1, \dots, m$, the new estimator utilizes a random subsample of lagged products. This is made possible by choosing the k_i at random. The weighting function $G_a(k_i)$ is determined in such a way that the bias of $\phi^*(\omega_a)$ is the same as the bias of $\hat{\phi}(\omega_a)$.

As would be expected the sampling variance of $\phi^*(\omega_a)$ is larger than the variance of $\hat{\phi}(\omega_a)$, since $\phi^*(\omega_a)$ is based on considerably fewer points. It was discovered,

however, that the variance of $\phi^*(\omega_a)$ was affected by the probabilities used in the selection of the k_i . Thus, the difference between the variances of the two estimators can be minimized by an appropriate choice of the probabilities $P(j)$. It was shown also that by selecting the integers $j = 0, 1, \dots, m$ with probabilities

$$P(j) = \frac{\sqrt{f(j)}}{\sum_{j=0}^m \sqrt{f(j)}},$$

where

$$f(j) = \frac{1}{n} \left[\rho^2(0) + \rho^2(j\Delta t) \right] P^2(j) G_a^2(j),$$

that the variance of $\phi^*(\omega_a)$ is minimized. For the special case, $\phi(\omega) = \lambda$ and the point $\frac{W}{2}$, it was shown that sam-

pling with equal probabilities is about half as efficient as with optimum probabilities.

Finally, some of the areas in which research has been carried out using power spectral analysis were considered. In particular, a problem from the field of aeronautical engineering research was used to demonstrate how the randomized estimator $\phi^*(\omega_a)$ would be calculated from real data. Using 900 observations on the pitching velocity of an aircraft, the power spectrum was estimated at ten points. The new estimator proved very tractable and it is felt that the loss of precision due to sampling will be more than offset by the economy and ease with which it produces estimates. This will be especially true when the need is for quick pilot estimates of spectra to be used in preliminary studies, as guidance for future research.

Microfilm \$2.75; Xerox \$5.80. 120 pages.

A SET-THEORETIC MODEL FOR LOGICAL SYSTEMS

(Order No. 61-3299)

Melvin Edward Conway, Ph.D.
Case Institute of Technology, 1961

An interpretation of a first-order functional calculus is constructed from (1) a set Z , each of whose elements is a set of two elements, and (2) a set of choice functions on subsets of Z . Several types of sets are defined to serve as individuals, statements, and predicates, by analogy with certain formal languages. The set of those choice functions defined on all of Z serves as a basis for a definition of truth of statements. Logical and factual truth is considered, proof is defined, and it is shown that provable predicates have logically true closures. The properties of intension and extension are derived, and it is shown that

intensions of statements and predicates are maps with homomorphic properties. A method is provided for counting intensions and extensions, and a conjecture concerning expressibility of predicates in terms of predicates of lower degree is discussed in terms of the model.

Microfilm \$2.75; Xerox \$3.80. 66 pages.

PERIODIC INTEGRAL SURFACES
FOR PERIODIC SYSTEMS OF
DIFFERENTIAL EQUATIONS

(Order No. 61-3039)

Donald D. James, Ph.D.

Iowa State University of Science and Technology, 1961

Supervisor: George Seifert

In this thesis we show the existence of periodic integral surfaces for two types of periodic systems of differential equations.

We consider the system

$$(1) \quad \dot{x} = X(t, x)$$

where x is an n -vector, $|x| = \sum_{i=1}^n |x_i|$, and X is con-

tinuously differentiable and periodic with period T . We assume that there is a constant $A > 0$ such that solutions

$\phi(t, x)$ of (1), such that $\phi(t_0, \alpha) = \alpha$, satisfy $|\phi(t_0 + T, \alpha)| \leq A$ for $|\alpha| \leq A$, that there are solutions $\phi(t, \alpha^*)$ and $\phi(t, \bar{\alpha})$, $\alpha^* \neq \bar{\alpha}$, which are periodic with period T , that

the elements of $\frac{\partial \phi(t, \alpha)}{\partial \alpha}$ are non-negative, and that there

is a constant $\rho > 0$ and positive integers k and ℓ such

$$\text{that } \frac{\partial \phi_\ell(t_0 + T, \alpha)}{\partial \alpha_k} > \rho.$$

We also consider the system (1) where $|x| = (\sum_{i=1}^n x_i^2)^{\frac{1}{2}}$

and X is continuously differentiable and periodic with period T . We assume that there are constants $0 < A_1 < A_2$ such that solutions $\phi(t, r, u)$ of (1), such that $\phi_i(0, r, u) = |\phi(0, r, u)| \cos u_i$, $i = 1, 2, \dots, n$, satisfy $A_1 \leq \phi(T, r, u) \leq A_2$ for $A_1 \leq r \leq A_2$. We let

$$\delta(r, u) = \frac{\phi(T, r, u)}{|\phi(T, r, u)|}$$

$$a(r, u) = \left| \frac{\partial \delta}{\partial r} \right|$$

$$b(r, u) = \left| \frac{\partial \delta}{\partial u} \right| - \frac{\partial |\phi(T, r, u)|}{\partial r} (n-1)^{\frac{1}{2}}$$

$$c(r, u) = \frac{\partial |\phi(T, r, u)|}{\partial u} (n-1)^{\frac{1}{2}}$$

and we assume that there is a number $B \geq 0$ such that the roots ρ_1 and ρ_2 of $a\rho^2 - b\rho + c = 0$ are non-negative and

satisfy $\rho_1 \leq B \leq \rho_2$, and that $\left| \frac{\partial \delta}{\partial u} \right| > \left| \frac{\partial \delta}{\partial r} \right| B$. We let

P_B be the set of all continuous functions f , periodic with period 2π , such that $A_1 \leq f(u) \leq A_2$, $f'(u)$ exists and is continuous, and $|f'(u)| \leq B$ for all u , and for each f in

P_B we assume that the equations $\delta_i(f(v), v) = \cos u_i$, $i = 1, 2, \dots, n$, define a continuously differentiable vector function $v(u)$ such that $v(u_1 + 2\pi, \dots, u_n + 2\pi) = (v_1(u) \pm 2\pi, \dots, v_n(u) \pm 2\pi)$ for all u .

Microfilm \$2.75; Xerox \$3.00. 21 pages.

ON THE ANALYSIS OF
PAIRED RANKED OBSERVATIONS

(Order No. 61-2914)

Leo Lynch, Ph.D.

Virginia Polytechnic Institute, 1958

The problem considered in this dissertation is the following: let π_1 and π_2 be two bivariate populations having unknown cumulative distribution functions $F_1(x_1, x_2)$ and $F_2(x_1, x_2)$, respectively. Assume that F_1 and F_2 are continuous and identical except possibly in location parameters. It is desired to test the null hypothesis

$$H_0: F_1(x_1, x_2) \equiv F_2(x_1, x_2)$$

against the alternative

$$H_0: F_1(x_1, x_2) \neq F_2(x_1, x_2)$$

It cannot be assumed that the variables x_1 and x_2 are statistically independent.

Suppose there are n_1 pairs of observations $(x_{11}, x_{21}), \dots, (x_{1n_1}, x_{2n_1})$ from population π_1 and n_2 pairs of observations $(x_{1n_1+1}, x_{2n_1+1}), \dots, (x_{1N}, x_{2N})$ from population π_2 , where $N = n_1 + n_2$. The x_{1i} ($i = 1, 2, \dots, N$) are ranked according to magnitude, the largest being assigned rank N . In a similar manner, ranks are assigned to the observations x_{2i} ($i = 1, 2, \dots, N$). It is assumed that there are no ties in ranks.

Let u_{1i} and u_{2i} denote the ranks assigned to x_{1i} and x_{2i} if these observations belong to population π_1 , and let u'_{1i} and u'_{2i} denote the ranks of these same observations if they belong to population π_2 . Since the sum of the first

N integers is $\frac{N(N+1)}{2}$, it follows that

$$\sum_{k=1}^{n_1} u_{ik} + \sum_{k=n_1+1}^N u'_{ik} = \frac{N(N+1)}{2}$$

If the N pairs of ranks are plotted on a plane, it is likely that the n_1 points from population π_1 and the

n_2 points from population π_2 will be interspersed forming a circular or elliptical pattern under the assumption that $F_1(x_1, x_2)$ and $F_2(x_1, x_2)$ are identical. Under the alternative hypothesis, it is likely that there will be a segregation of the points into two groups. A test statistic, S_1^2 is constructed to measure the extent of this segregation.

The S_1^2 -statistic proposed here, is based on the Euclidean distance between the centroids of the ranks belonging to π_1 and π_2 , in particular,

$$S_1^2 = (\bar{u}_1 - \bar{u}_1')^2 + (\bar{u}_2 - \bar{u}_2')^2$$

where

$$u_1 = n_1^{-1} \sum_{k=1}^{n_1} u_{1k}, \quad u_1' = n_2^{-1} \sum_{k=n_1+1}^N u_{1k}$$

The first two moments of S_1^2 are derived under the following conditional randomization procedure: keeping the ranks paired as given in the sample, n_1 pairs are selected at random (with equal probabilities) from among the $N = n_1 + n_2$ pairs and assigned to population π_1 ; the remaining n_2 pairs are assigned to population π_2 . It is shown that

$$E(S_1^2) = \frac{N^2(N+1)}{6 n_1 n_2}$$

and

$$\sigma_{S_1^2}^2 = a_{00} + a_{11}A_{11} + a_{12}A_{12} + a_{21}A_{21} + a_{22}A_{22} + a_{11,11}A_{11}^2$$

where $A_{rs} = \sum_{k=1}^N u_{1k}^r u_{2k}^s$ are parameters depending on the

sample, and the coefficients a_{00} , a_{11} , a_{12} , a_{22} and $a_{11,11}$ have been tabulated for values of n_1 and n_2 up to 20.

The exact sampling distribution of S_1^2 is unknown. However, it is shown that the distribution of $\frac{kE(S_1^2)}{\sigma_{S_1^2}^2}$ is approximately χ^2 with $\frac{2[E(S_1^2)]^2}{\sigma_{S_1^2}^2}$ degrees of freedom.

A rank analogue of Wald's modification of Hotelling's T^2 is given and the first two moments obtained. Also, a multivariate extension is considered and a statistic, $S_1^2(k, 2)$, constructed. The expectation and variance of $S_1^2(k, 2)$ are derived. A multi-population extension for the case of bivariate populations is given and the expectation is derived for a statistic, $S_1^2(2, p)$. A statistic, $S_1^2(k, p)$ is constructed for the most general case and its expectation is given.

An alternative approach to the problem, also investigated, is by means of discriminant analysis. In this case simplified formulas are given for the calculation of the components of a vector which provides optimum discrimination. It is shown that this method is not a fruitful one for the construction of tests of significance pertaining to the original null hypothesis.

Microfilm \$2.75; Xerox \$3.80. 69 pages.

ENTIRE FUNCTIONS WITH RESTRAINTS ON THE ZEROS OF THE PARTIAL SUMS

(Order No. 61-3137)

Thomas La Rue McCoy, Ph.D.
The University of Wisconsin, 1961

Supervisor: Jacob Korevaar

Our topic is the problem of obtaining upper bounds for the coefficients of the entire function $f(z) = 1 + a_1 z + a_2 z^2 + \dots + a_n z^n + \dots$ when restrictions are placed on the the distribution of the zeros of the partial sums $p_n(z)$ of $f(z)$.

Work of F. Carlson, P. Rosenbloom, and J. Korevaar shows that if some angular aperture of fixed magnitude is free of zeros of $p_n(z)$, for all n , then f is of order zero; that is, $|a_n| < e^{-Kn \log n}$ for arbitrarily large K , and

$n > n(K)$. A. Edrei has recently shown that if for each n the zeros of p_n all lie in a closed half-plane with boundary passing through the origin, then there exist positive numbers A and n_0 such that $|a_n| < e^{-An^2}$ for $n > n_0$. The

present thesis grew out of an investigation of the possibility of extending Edrei's result to the case where the zero-free aperture is smaller than a half-plane.

In the case where all the zeros of $p_n(z)$ lie outside an arbitrarily small fixed aperture, for all n , we obtain for some $A > 0$ the inequality

$$|a_n| < e^{-An \log n \log \log n}, \quad n > n_0.$$

A region R of the complex plane will be called admissible if, whenever the points z_j , $j = 1, 2, \dots, n$ lie in R , we have an inequality

$$\sum_{j=1}^n |z_j|^m \leq K \max_{1 \leq \alpha \leq m} \left| \sum_{j=1}^n z_j^\alpha \right|^{m/\alpha},$$

where m and K depend only on R . We show that if for each n the zeros of $p_n(z)$ lie in a set R_n which can be obtained from a fixed admissible region R by expansion and rotation, then we have again the inequality

$$|a_n| < e^{-An^2}, \quad n > n_0, \quad A > 0.$$

This result contains Edrei's theorem as a special case.

If for all n we have an inequality

$$|p_n(z)| > \gamma |a_n z^n|, \quad \gamma > 0 \text{ and fixed, throughout}$$

some fixed angular aperture, then

$$|a_n| < e^{-An \log^2 n}, \quad A > 0, \quad n > n_0,$$

and if in addition the points $(n, \log |a_n|^{-1})$ form a convex polygonal line, we obtain again Edrei's estimate.

Many of the above results are refined to allow certain fixed apertures to contain, in some sense, a very small number of the zeros of the p_n .

The question also arises; what sort of zero-free regions imply order zero for the limit function? An example is constructed which shows, among other things, that such a region cannot be much thinner than an angular aperture.

Microfilm \$2.75; Xerox \$4.00. 73 pages.

SOME RESULTS ON QUEUING
AND VULNERABILITY RELEVANT TO
AIRCRAFT MAINTENANCE

(Order No. 61-3310)

Paul Peach, Ph.D.
Case Institute of Technology, 1961

This thesis studies some aspects of the problem of optimally dispersing maintenance facilities for aircraft. Dispersion gives better accessibility and reduced vulnerability, but also incurs losses due to increased supply costs, queue sizes, and idle facilities.

To apply the methods of operations research to this problem, extensions of queuing and programming theory are needed, along with appropriate algorithms. The thesis develops a theory of finite circular queues and shows how various models of this kind can be applied to maintenance problems. Algorithms and approximations help estimate the change in effectiveness of a system when its components are dispersed. The critical quantities are the P_n , the probability of n aircraft in a dispersed shop.

A study of vulnerability, using an approach analogous to linear programming, shows that if the enemy allocates his attack potential optimally he must equalize the marginal return on all targets. A measure is proposed, called susceptibility, which combines military value and hardness, and it is shown that no gain in expected life results from dispersing targets beyond a critical value for susceptibility.

With the results of the thesis it is possible, for any situation in which the necessary data are available, to calculate the loss in efficiency and the gain in expected life due to dispersion.

Microfilm \$2.75; Xerox \$5.00. 98 pages.

AN INTEGRATED JOB SHOP
SEQUENCING PROBLEM

(Order No. 61-3311)

Rudolf Nicolas Cadok Reinitz, Ph.D.
Case Institute of Technology, 1961

The sequencing problem in a job shop is investigated. A job shop is viewed as a collection of decentralized machine centers, each of which processes the flow of jobs routed through it. The operation of an individual center and its queue of waiting jobs are represented as a Markov process (continuous in time and discrete in space).

For an individual machine center we discuss: (1) the waiting and completion time distribution functions for each job class under a given sequencing rule, (2) the loss rate associated with a sequencing rule, (3) an optimal sequencing procedure based on the individual center load and cost parameters.

The over-all shop is represented as a synthesis of the individual machine center models. The problem of setting realistic order due dates and the effect of the flow intensity of orders on profits is examined.

Several suboptimal sequencing procedures are developed. They are sequential decision processes with explicit rules which are relatively simple to apply. The

results are not subject to the assumptions generally needed for mathematical treatment of this class of problems (e.g., steady state, exponential or related service time distributions, finite number of states, etc.).

Finally, empirical data from a job shop in the steel industry are used to test the applicability of the procedures. The various sequencing rules are derived and their effectiveness evaluated.

Microfilm \$2.75; Xerox \$5.60. 112 pages.

SOME RESULTS ON DEFINABILITY AND
DECIDABILITY IN ELEMENTARY THEORIES.
(PARTS I-V).

(Order No. Mic 61-490)

Hartley Rogers, Jr., Ph.D.
Princeton University, 1953

In J.S.L. 16 (1951), 239-240, Church and Quine show that a general binary relation is definable from a symmetric relation in the sense that an expression of quantification theory exists, in one binary function variable and two free individual variables, such that as symmetric relations are assigned to the function variable, the value of the entire expression runs through all binary relations. The general decision problem for quantification theory thus reduces to that for a single symmetric relation. As intermediate degrees of undecidability may possibly exist, this is at present somewhat stronger than an undecidability result alone. Using relation-sets -- elementary theory models which are values for higher variables in third-order functional calculus -- the writer develops a theoretical framework for results of this general kind. The theory accommodates results somewhat beyond the immediate definability method of the Church-Quine paper. The theory is applied to obtain reduction-undecidability-definability for the elementary theory of a single binary disjoint relation (domain and co-domain disjoint), of a single symmetric reflexive relation, and of a single transitive reflexive relation. Reduction-undecidability results are obtained for the cases of two equivalences, one equivalence and one total order, and two total orders.

A decision method for the elementary theory of a single equivalence is known, also for monadic quantification theory with identity -- i.e., the elementary theory of a single equivalence R and any number of singular relations F_i which are well-defined with respect to that equivalence ($R(x,y) \Rightarrow_{xy} F_i(x) \Rightarrow F_i(y)$ is true). These results are here extended by deriving decision methods for the elementary theory of a single symmetric and transitive relation, and for the elementary theory of a single equivalence together with any number of singular relations, well-defined or not. By the elementary theory of rectangular arrays we shall mean that theory obtained when we consider matrix arrays of 0's and 1's, use two binary constants C and R interpreted as 'in the same column as' and 'in the same row as,' consider occurrences of 1's as individuals, and construct formulas within quantification theory. Results of this paper and the preceding paper are used together to show that the theories of $m \times \text{finite}$, $m \times \infty$, as well as $m \times n$ arrays are decidable, while the theory of $\infty \times \infty$ arrays is undecidable though axiomatizable.

The theories for finite \times finite and finite $\times \infty$ arrays are shown equivalent, though decision and axiomatizability here remain undetermined.

Microfilm \$2.75; Xerox \$5.40. 109 pages.

DIAGRAM NORMAL FORMS AND THEIR APPLICATIONS TO THE THEORY OF MODELS

(Order No. Mic 61-1978)

Konrad Suprunowicz, Ph.D.
The University of Nebraska, 1961

Adviser: Hugo B. Ribeiro

Let the formalized theory T be an applied predicate calculus with identity, containing k predicate symbols $P_i(\dots)$ of ranks r_i .

Definition: a sentence $\delta(n)$ of the theory T is called a diagram sentence of length n if and only if $\delta(n)$ is an existential sentence $\exists x_1 \exists x_2 \dots \exists x_n \alpha$ where α is a conjunction $\alpha_1 \wedge \alpha_2 \wedge \dots \wedge \alpha_k \wedge \epsilon$ of quantifier free formulae $\alpha_1, \alpha_2, \dots, \alpha_k, \epsilon$ and 1) for every $i \leq k$, α_i is a conjunction of atomic formulae $P_i(\dots)$ or their negations $\sim P_i(\dots)$ such that for every sequence $\langle x_{j_1}, x_{j_2}, \dots, x_{j_{r_i}} \rangle$ of elements of the set $X(n) = \{x_1, x_2, \dots, x_n\}$ just one of $P_i(x_{j_1}, x_{j_2}, \dots, x_{j_{r_i}})$ and $\sim P_i(x_{j_1}, x_{j_2}, \dots, x_{j_{r_i}})$ appears in α_i , 2) ϵ is the conjunction of the formulae

$\sim(x_p = x_q)$ for every one of the $\binom{n}{2}$ subsets of two distinct elements from the set $X(n)$.

It is, first, constructively proved that every consistent existential sentence β of T , whose prenex normal form contains n quantifiers is equivalent to a disjunction of a finite number of diagram sentences, each of length not exceeding n . This disjunction, called diagram normal form of β , is unique up to the order of terms. A dual result for universal sentences of T is immediately derived.

The above theorem and its consequences are then used in the formulation and solution of several problems of the theory of models (a theory which deals with the study of mutual relations between the properties of mathematical systems and the structural form of the set of linguistic expressions used to define those systems). Since Birkhoff's "On the structure of abstract algebras" of 1935 this theory of models has been developed through fundamental works of A. Tarski, L. Henkin, A. Robinson, R. C. Lyndon and others.

L. Henkin as well as other authors has studied the concept of finite embedding property, and before that, the notion of finite reducibility has been used in connection with decision problems. In this thesis finite embeddability is characterized in terms of finite reducibility. Indeed, we show that a class L of relational systems (in particular algebras) has the finite embedding property if and only if the set of all universal sentences of the formalized theory, within which L is discussed, is finitely reducible with respect to L . It is proved, further, that if a class L has the finite embedding property and \bar{L} is the intersec-

tion of all universal classes containing L , and N is any class such that $L \subseteq N$, then the class $N \cap \bar{L}$ has the finite embedding property already with respect to the finite systems of L . This is applied to prove the existence of a class of groups with the finite embedding property which contains properly the class of Abelian groups.

The notion of universal completeness has been introduced into the theory of models and extensively studied by H. Ribeiro. Further results concerning this notion are proved in this thesis, in particular, a sufficient condition is given for a set of sentences to be maximal universally complete. It is proved that universally complete sets of sentences which have models of arbitrary large finite cardinality possess necessarily the finite embedding property. The theorem on diagram sentences is also applied to the study of two new notions which are suggested by that of universal completeness. N -universally complete sets of sentences are characterized in terms of embeddability properties of the classes of their models. Similarly are characterized sets of sentences which are universally complete relatively to simpler theories. Examples are discussed.

Microfilm \$2.75; Xerox \$3.00. 48 pages.

THE INVENTORY PROBLEM WITH PERIODIC REORDER

(Order No. 61-3316)

Arthur Joel Yasan, Ph.D.
Case Institute of Technology, 1961

A solution is given for the static inventory problem with lost sales and delivery time lag, in the case of periodic reordering and proportional component inventory costs. The solution is quite general, in that the period-by-period demands may follow any known joint distribution, and the delivery time lag may be any fixed integral number of periods. The same approach yields the familiar solutions for the instantaneous receipt case and the back order lag case. These solutions are carried out to the point of numerical decision tables, for the useful special case where demands are independent, and normally distributed with the same standard deviation about a changing forecast. Subsidiary sections are given to the expected inventory cost with an optimal policy, optimal adjustment rules in situations where order adjustments are permitted, the two-stage dynamic inventory problem, and a review of the existing literature on the N -stage problem.

Microfilm \$2.75; Xerox \$6.80. 145 pages.

RELATIONS BETWEEN THE LOTOTSKY AND CERTAIN OTHER METHODS OF SUMMABILITY

(Order No. 61-3291)

Bernard James Yozwiak, Ph.D.
University of Pittsburgh, 1961

A matrix method of summation introduced by A. V. Lototsky (Lotockii) in 1953 and called the Lototsky

method by R. P. Agnew, was studied and compared with certain other methods of summability. The Lototsky or L-method is defined as follows: For each $n = 1, 2, 3, \dots$, let $p_n(x)$ be the polynomial of degree n defined by $p_n(x) = x(x+1)(x+2)\cdots(x+n-1)$, and let the constants $p_{n1}, p_{n2}, \dots, p_{nn}$ be defined by $p_n(x) = p_{n1}x + p_{n2}x^2 + p_{n3}x^3 + \dots + p_{nn}x^n$ with $p_{nk} = 0$ when $k < 1$ and when $k > n$. Let

$$(1) \quad \sigma_n = \frac{1}{n!} \sum_{m=1}^n p_{nm} s_m,$$

then a series $u_1 + u_2 + \dots$ and its sequence s_1, s_2, \dots of partial sums will be called evaluable Lototsky to σ if $\sigma_n \rightarrow \sigma$ as $n \rightarrow \infty$.

A collection of relations which exist among the constants p_{nm} and the q_{nm} of the inverse method is compiled. Some of these relations are original and others are obtained by noting the relationship existing between these constants and the well known Stirling numbers. Any attempt to apply the Lototsky method indicates a necessity for these relations.

Most of the paper is devoted to comparing the Lototsky method with the Z_k -method of summability. The Z_k -method is defined by

$$(2) \quad t_n = \frac{1}{k+1} (s_{n-k} + s_{n-k+1} + \dots + s_n),$$

where $s_n = 0$ for $n < 0$, and k is a fixed positive integer. If $t_n \rightarrow t$ as $n \rightarrow \infty$, then sequence $\{s_n\}$ is said to be evaluable Z_k to t . The result that the Z_k method does not include the L-method is proved by showing that the $Z_k L^{-1}$ matrix is not regular and also by giving an example of a series that is summable L but not Z_k . The question whether the L-method includes the Z_k was par-

tially answered by proving that the LZ_1^{-1} matrix is regular and thereby arriving at the fact that the L-method included the Z_1 -method. Another result obtained was that the Z_k and L methods are consistent.

An iteration of the two methods mentioned above led to the result that the LZ_k -method is at least as powerful as the L-method. The power of the $Z_k L$ -method was partially answered by the result that the $Z_1 L$ -method is more powerful than the Z_1 . A corollary states that the LZ_k -method includes the Euler, E_r , method, if r is real and positive.

By illustrating with counterexamples, two of Agnew's results were re-established, namely, that neither the Abel method nor the Cesaro method can include the Lototsky method.

The paper is concluded with a discussion of a generalization of the Z_k -method. This is designated $Z_{k(a_n)}$ and defined by the transformation

$$(3) \quad g_n = t_{n+a_n}$$

where t_n is defined in (2) and a_n , $n = 0, 1, 2, \dots$, is any sequence of integers--positive or negative. It is shown that if $\{a_n\}$ has a lower bound, the $Z_{k(a_n)}$ method is regular. Further, under the condition that $\{a_n\}$ is bounded, $t_n \rightarrow s$ implies $g_n \rightarrow s$, as $n \rightarrow \infty$; for s finite or infinite. In addition, several theorems are included dealing with sequences for which t_n oscillates. If t_n oscillates between two values A and B , it is shown that with proper choice of $\{a_n\}$, g_n can converge either to A or B , or neither. In these cases, the $Z_{k(a_n)}$ method is not consistent with the Lototsky method. Additional comments are included dealing with unbounded $\{a_n\}$.

Microfilm \$2.75; Xerox \$4.00. 75 pages.

MUSIC

HISTORY OF THE INDIANAPOLIS SYMPHONY ORCHESTRA

(Order No. 61-3006)

Samuel Wasson Siurua, Mus.Ed.D.
Indiana University, 1961

This study is an historical account of the Indianapolis Symphony Orchestra, the story of how this orchestra came into existence and fulfilled its cultural purpose in a mid-western city. The symphony orchestra in Indianapolis, as in most American cities, enjoys the prestige of being one of the city's major cultural enterprises and its principal medium for the dissemination of the musical art.

The information upon which this narrative is based has been gathered from various sources. Details of the operation of the orchestra, or its struggle for a modicum of financial security, and of the policies pursued in conducting its affairs were found in the minutes of the Indiana State Symphony Society and of the Women's Committee of the Society. Newspaper accounts were a fruitful source, as the local critics have maintained an active interest in the

orchestra. Bound volumes of the orchestra's programs contained information pertaining to its repertory, its personnel, and events in the orchestra's life. The writer gained considerable insight into the circumstances surrounding the founding and operation of the orchestra from interviews with several significant figures closely associated with the orchestra.

Chapter I of this study is in two sections. The first section is a sketch of the economic growth of Indianapolis from its founding in 1821 as a small frontier state capital to 1930 when it stood as a city favored by the political prestige implicit in its position as the capital city of Indiana. The second section deals with the city's early musical life as revealed through the activities of local musical groups which were organized soon after the city was founded. Through concerts and festivals promoted by these groups, the talents of local musicians were employed; and on occasion the city's musical life was enriched by touring artists and performing groups.

In Chapter II is found the story of the orchestra's founding in 1930. Through personal dedication and perseverance the founder, Ferdinand Schaefer, held together a

group of the city's unemployed theater musicians and amateurs who comprised this embryonic orchestra. This group, assembled during the depths of a financial depression, played four to six concerts per season for seven years with remuneration determined solely by door receipts. This modest beginning is credited with inspiring a number of the city's civic and cultural leaders to assume the responsibility for maintaining a major orchestra.

In Chapter III the writer continues to trace the season-by-season existence of this orchestra after its reorganization as a major symphony orchestra in 1937 under the leadership of Fabien Sevitsky. This method of chronicling the events in the history of the orchestra was not chosen arbitrarily, but was followed because the life of a major symphony orchestra is paced to a season-by-season existence. While plans are shaped with long-term goals in mind, the principal concerns of supporting agencies are for the "current season." Each season has its distinct character, presents its particular problems, and in most cases is financed separately.

The author points out that a major orchestra in a community is not only a cultural asset, but is also an expen-

sive cultural and civic responsibility. The Indiana State Symphony Society was formed to assume the responsibility of maintaining the Indianapolis Symphony Orchestra. As its name indicates, this Society was conceived as an agency to provide a basis for statewide support of the orchestra.

Despite the extensive scope of its Society and a \$60,000.00 civic grant the Indianapolis Symphony Orchestra has throughout its life ranked near the lowest in budget size of major orchestras. This factor has resulted in relatively short seasons and a large personnel turnover. In spite of this disadvantage, the Indianapolis Symphony Orchestra has achieved prominence through the strong leadership that has been exerted by its conductors.

Chapter IV is concerned with the orchestra's third period which began in 1956 when Izler Solomon, the orchestra's third conductor, was engaged to be its leader. The chapter treats generally the events of this four-year portion of the orchestra's history, concluding with the orchestra's thirtieth anniversary. A closing section reflects on the factors affecting the viability of this orchestra which stands as an index to the cultural maturity of the city. Microfilm \$3.50; Xerox \$12.40. 271 pages.

PHARMACOLOGY

A STUDY OF THE BIOLOGICAL CLASSIFICATION OF CHEMICALS BY THEIR PHYSICAL PROPERTIES

(Order No. 61-3294)

Emil Alvin Pfitzer, Sc.D.Hyg.
University of Pittsburgh, 1961

Supervisor: Theodore F. Hatch

There is an increasing need for more rapid means for classifying chemicals according to their biological effect. One suggestion has been that biological effects from chemicals may be broadly separated into two groups, as either structurally specific, or nonspecific. Structurally nonspecific effects appear to result from the physical accumulation of the chemical at some site within a cell, whereas structurally specific effects appear to be dependent upon chemical interaction with a cellular receptor. It has been observed that the potency or degree of effect of structurally nonspecific chemicals is related to certain physical properties (e.g., solubility and vapor pressure) of the chemicals.

In particular, this study examined those concepts which suggested that equal biological effects are produced by structurally nonspecific chemicals when equal quantities of chemicals are present at the site of effect, these quantities being expressed as: (1) molar concentration, (2) activity (thermodynamic), or (3) volume fraction. Activity, the measurement of which required no knowledge of the site of action, was originally suggested only as a means of classifying structurally nonspecific chemicals (not as a fundamental constant related to effect), and its use for this purpose was examined. Approximately fifty chemicals

were utilized by measuring their effect on (1) the inhibition of growth, (2) the depression of respiration, and (3) the viability of yeast cells. These data, in conjunction with data from the literature, formed the basis for the discussions and conclusions of this study.

It was concluded that activity does not provide a reliable basis for classifying structurally nonspecific chemicals because: (1) although the activity values fell within a relatively narrow range compared to concentrations in the external environment, these values sometimes exhibited a range of a hundredfold or more, and there was no basis for establishing the lower limit of this range; (2) the activity values within the range did not show a random scatter, but had identifiable trends characteristic of different chemical groups, which trends were not predictable and often varied from one test system to another; and (3) an activity value for a new chemical, which fell within the narrow range, but well away (graphically) from the values of other chemicals tested in the same system, could not be classified independently, in its own right, but only by comparison with the observed activity values of very similar chemicals. It was also noted that the indices of molar concentration or volume fraction at the site of effect showed a highly significant narrowing of the range of values as compared with associated external concentrations, but that there were still identifiable differences between chemical groups. The conclusion was reached that these indices were not sufficient, alone, as parameters of physical toxicity.

A further detailed examination of the theoretical basis for the proposed theories and concepts led to the following new concept: that equi-effect by structurally nonspecific chemicals is produced by equi-energy involvement at the site. The energy involvement at the site was considered

to be the free energy of mixing of the chemical when it enters the site of effect. This concept is, in fact, a combination of the use of activity and the concept of equimolar concentration at the site and, thus, loses the convenience of activity because of the need for knowledge of the site.

The validity of the energy concept was supported by the striking constancy of the estimated energy involvement

at the site for the data of this study as well as for other data in the literature. However, a more significant observation, that gives particular support to the energy concept, is that identifiable trends and differences between chemical groups, as noted in tests of previous concepts, appeared to have been replaced by a random scatter of the energy values about a constant.

Microfilm \$2.75; Xerox \$5.60. 114 pages.

PHILOSOPHY

MORAL OBJECTIVISM IN
W. R. SORLEY, W. D. ROSS,
A. C. EWING, AND A. C. GARNETT.

(Order No. Mic 61-710)

Robert Edward Bergmark, Ph.D.
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Major Professor: Dr. John H. Lavelly

It is the aim of this dissertation to examine the systems of thought of four recent and contemporary objectivists in moral theory, W. R. Sorley, W. D. Ross, A. C. Ewing, and A. C. Garnett, with a view to evaluating the case which they make for moral objectivism.

Sorley, beginning with a study of judgments of approval and disapproval, argued that such judgments claim objective validity, and, when analyzed, reveal a pattern of basic principles of moral worth. These principles are universally valid, and constitute a system of moral laws. The primary contributions of Sorley's system are to be seen in his use of coherence; in his insistence upon the significance of the person in relation to value; and in his concept of moral laws. The primary weaknesses are to be seen in his failure to distinguish adequately between value and obligation and in his appeal to intuition at crucial points in his theory.

Ross, distinguishing carefully between "right" and "good," argued that "right" is the more significant term for ethical theory. Right acts are acts which are "suitable." Moral objectivism is implicit in his concept of "suitability." The primary contributions of his system are to be seen in his critical analysis of "ought" and "good" and in his insistence upon the significance, to the moral life, of special obligations. The primary weaknesses are to be seen in his failure to develop an analysis of the self; in his dependence upon intuition; in his failure to be more explicit concerning the objective realm in terms of which "suitability" finds its meaning; and in his failure to explain more adequately the relationship between "ought" and "good."

Ewing, influenced by Ross, attempted to overcome the difficulties in Ross's system. Ewing's moral objectivism is implicit in his concept of "fittingness." The primary contributions of his system are to be seen in his use of a type of coherence test of truth; in his development, beyond Ross, of a more thoroughly integrated system in which "ought" and "good" are related; and in his development, beyond Ross, of a more thorough analysis of "ought"

and "good." The primary weaknesses are to be seen in his frequent dependence upon intuition and in his failure to trace out the objective implications of his notion of "fittingness."

Garnett developed a theory of moral objectivism in terms of a universally valid system of moral laws. These laws describe the requirements which must be met if the potentialities of the self are to be realized. The primary contributions of his system are to be seen in his thoroughgoing dependence upon coherence; in his development, beyond Ross and Ewing, of a more complete analysis of ethical terms; in his psychological analysis of the self; in his theory of self-realization; and in his concept of moral laws. The primary weaknesses are to be seen in his failure to be more precise about the nature of the "altruistic will" and about the manner in which one comes to know the significance of altruistic acts, and in his failure to treat more explicitly the experience of desire.

With reference to the thought of these four men, the following general conclusions can be drawn: (1.) A rational case for moral objectivism can better be made by means of a dependence upon coherence rather than intuition. (2.) A theory of self-realization, with its description of the nature of the self, provides a fixed point of reference in terms of which moral terms can be understood and moral experience interpreted. (3.) Of the four systems of thought analyzed in this dissertation, Garnett's theory provides the most defensible case for moral objectivism. Microfilm \$3.40; Xerox \$11.95. 261 pages.

THE MORAL IMPLICATIONS OF
JAMES'S PRAGMATISM

(Order No. Mic 61-1563)

Bernard Patrick Brennan, Ph.D.
Fordham University, 1961

Mentor: J. Quentin Lauer, S.J.

This dissertation presents the results of an investigation made to determine the positive moral implications of the pragmatism of William James, with specific reference to the connections between his ethical views and his pragmatically oriented theories in metaphysics, religion, and epistemology. The published writings of James were read

with special reference to all specific statements on ethics; in addition, special attention was paid to metaphysical, religious, and epistemological problems to discover their relationships to his ethical views. Next James's statements were correlated, analyzed, and cast into a synthesis; throughout the whole process, an attempt was made to keep constantly in mind the relevance of all of these to his pragmatism and his ethics, and to show how his interest in the moral nature of man shapes all his thinking.

Emphasis was placed upon the published works of James, with relatively little reference to secondary sources. General histories of American philosophy and monographs on James did not prove particularly valuable. As a rule, statements on the subject of the ethics of James were found to be too general, too partisan, or too polemic to be useful.

It was found that James's ethical views play a central role in all parts of his philosophy. For example, he regarded beliefs in religion, metaphysics, and epistemology as true only when they are both "pragmatic" and helpful in the fulfillment of man's moral cravings. A viewpoint is pragmatic when it is such that its acceptance or rejection makes a difference for men in their practical life or conduct; on the other hand, a viewpoint which makes no practical difference to any man is neither true nor false but actually meaningless. Moreover, a true view will not clash with man's moral cravings; James asserts that it is right for men to consult their subjective moral cravings when they are determining the truth of a belief. Man's desires, for example, for a universe in which he can feel morally "at home" and for a God with whom he can have fruitful communion, are every bit as "legitimate" as sources of knowledge as any data given by physical phenomena can be, and such desires, in their various ways, point to the existence of a corresponding "objective" reality.

James applies his pragmatic criteria rigidly to his religious views. His God is a "working" God, a divine being from whom have been removed all attributes which do not have pragmatic significance; for example, God's aseity, His necessariness, His immateriality, His actualized infinity, and all His other metaphysical attributes are dismissed as having no pragmatic significance. On the other hand, James admits the moral attributes of God since they have pragmatic value in determining man's fears, hopes, and expectations.

Just as James judges religious beliefs by their pragmatic significance with specific reference to man's moral life, so also does he judge all doctrines proposed in metaphysics; those doctrines are true which alter a man's conduct in a morally desirable way; on the other hand, those doctrines which have no pragmatic significance are false, as well as those which have a pragmatic significance that operates against the fulfillment of man's moral cravings.

James's pragmatic theory regarding human knowledge, presupposed in his metaphysics and philosophy of religion, affirms again the doctrine that true knowledge must be practical and morally useful. For James, the goal of philosophy is conduct; purely speculative knowledge, that is, knowledge which does not affect human actions, is unreal and thus "untrue."

To achieve a theory of knowledge which itself would be morally useful, James combined the pragmatist theory of truth with his own modified variety of empiricism, which he called Radical Empiricism.

This investigation of the moral implications of James's

pragmatism indicates that the central and abiding concern throughout James's philosophy is his desire to defend the moral personality of man. His views are all formulated with the purpose of providing a philosophical vindication of man's moral cravings. Only those views which promote the development of the moral life of man are true; this is one of the essential implications of James's pragmatism.

Microfilm \$3.00; Xerox \$10.60. 232 pages.

THE WILL AND ITS FREEDOM
IN THE THOUGHT OF PLATO, ARISTOTLE,
AUGUSTINE, AND KANT.

(Order No. Mic 61-1099)

Peter Vincent Corea, Ph.D.
Boston University Graduate School, 1961

Major Professor: Richard M. Millard

1. Problem. The problem of this dissertation is to examine the doctrines of the will in the thought of Plato, Aristotle, Augustine, and Kant and to relate their conceptions of freedom to their doctrines of the will.

2. Method. The method consists in examining primary sources which define and interpret the will and its freedom.

3. Summary. Plato defines the soul as that which is moved by itself. There is not a will as a self-determining faculty which is free, but rather a self-determining soul which wills itself freely as a unity.

In Aristotle the soul itself does not move. What moves are the faculties. Free will as the faculty of moral choice is the "middle faculty," the practical reason, between the extremes of theoretical reason (maximal soul--*Nous*) and moving desire (minimal soul--body).

In Augustine the will is that which controls the motion of the soul from which, as a faculty, the will derives its power. The will selects among alternatives. In man's first state he is free, but once he chooses he is no longer free. He has only two choices: to obey God, or to sin. Either choice costs him his free will. Salvation can come only as the gift of God's grace. Salvation is perfect freedom.

For Kant, the will is a cause which functions as a law to itself--the pure practical reason. Free will as an entirely self-determining causality acts in the world of sense as conditioned, and, at the same time, in the world of noumena as absolutely unconditioned.

4. Conclusions. There are three aspects to the problem of free will: the psychological, the moral, and the metaphysical aspects.

In relation to the psychological aspect of the problem, Plato's view of the soul's ability to will itself as a self-directing unity of consciousness is the point of departure for subsequent doctrines of free will. Aristotle, however, claims that the soul cannot be moved as a first cause and that the varieties of functions of the soul are due to the parts of the soul acting as faculties for the soul. Augustine points out that the will neither wills successfully nor obeys its own commands. Kant builds on the Platonic foundation.

Morally, free will in Plato concerns making a right choice. Virtue is not found by a capricious act of free will.

A free will cannot choose the good unless it is the action of the whole soul directed to the good by reason. Augustine and Aristotle point out that the soul's self-determination is not ultimate but subject to the commands of other faculties and forces. Kant reaffirms the view that the mind commands the will.

Metaphysically, free will helps define first principles. For Plato, the first principle is self-motion. For Aristotle, free will applies to the faculties the soul uses. For Augustine, the first principle is the absolutely free will of God. For Kant, free will is the central reality of the noumenal world with the power to create absolute beginnings.

Microfilm \$4.65; Xerox \$16.45. 364 pages.

THE METAPHYSICAL AND EPISTEMOLOGICAL
PRESUPPOSITIONS OF H. WEYL'S
CONCEPTION OF MATHEMATICS

(Order No. Mic 61-1573)

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Fordham University, 1961

Mentor: Professor Elizabeth G. Salmon

This dissertation has for its purpose the discovery of the philosophical presuppositions of that view of mathematics detailed by a leading mathematician of this century, Hermann Weyl. The problems of foundation arising from Weyl's conception of mathematics have been analyzed on their own grounds to determine their presuppositions.

The principal source for this investigation has been Weyl's final expression of his view, the *Philosophy of Mathematics and Natural Science* (1949). Other works were consulted to clarify obscurities and to put in focus the modern views of number, especially those of Russell, Dedekind and Cantor. Russell, especially, is significant in the light of his research on the Cantorian set-theoretical approach and on the Paradoxes, both of which are dominant in modern mathematics. Likewise, some papers of Hilbert and Gödel have been consulted because of Weyl's concern with the Formalist view.

The author has stressed the importance of mathematical definition because the relational character of mathematics is given its direction here and because this relationalism becomes the foundation for the intelligibility of mathematics for Weyl. Further, the distinctively constructive character of Weyl's mathematics is rooted in a type of definition.

It has been found that what is significant is not the nature of the mathematical object but the way it is given. The relational expression for this given indicates how it is to be constructed and this construction, in turn, guarantees the possibility of the actual exhibition of the object, thereby indicating its "existence." The author has observed that the difficulty in imagining the objective feature with regard to which this kind of definition can generate new classes of objects reflects on the insufficiency of relation to yield full intelligibility.

The author agrees with Weyl that treatment of an indefinitely open series or set as a closed aggregate of "existent" objects can generate the paradoxes and that decision as to the truth or falsity of a proposition in the

realm of the mathematical infinite or indeterminate is generally not possible, but in the author's view, this is due ultimately not to a necessary restriction to the intuitively given but to the potency of material being which he regards as the foundation of number.

Weyl preserves finite mathematics from complete tautology by appeal to induction which for him confers on it a synthetic character. The author holds that if induction is founded on the real as recognized by mind, there would be at least the possibility of universally valid statements in mathematics. For although the extensive-aspect of the "all" is stressed in mathematics, the full intelligibility of this presupposes a nature-aspect at the foundation of the abstractions resulting in the idea of number which is grasped in the induction. Weyl's inductive process of repetition of the same relation restricts certainty to what can actually be pointed out. On the other hand, "existential" set theory overlooks the indeterminate character of the continuum and posits decidability where there can be only conjecture. Further, the unrestricted and nominalistic use of the "all" in this latter approach appears to generate paradox and contradiction.

Weyl understands the given number continuum to be constructed by successive "ones"; so this successive ordering implies the priority of ordinal number; cardinal number has a functional or representative role in the ordered series. The author has pointed out that this character of the continuum presupposes the potency of material being and a doctrine of the mathematical "one" and the transcendental "one." The author has concluded that Weyl's analysis involves presuppositions rendering it inadequate to fully explain his conception of mathematics and has suggested a foundation to better ground it.

Microfilm \$2.75; Xerox \$8.80. 194 pages.

THE DEFINITION OF CATEGORY IN
ARISTOTLE, KANT, AND BOWNE.

(Order No. Mic 61-709)

Benjamin Aby Petty, Ph.D.
Boston University Graduate School, 1961

Major Professor: John H. Lavelly

The problem of this dissertation is to determine how Aristotle, Kant, and Bowne defined a category. This question is one which has neither been answered previously nor approached through an exhaustive analysis of relevant texts.

The dissertation examines first Aristotle's *Categories*. This early document suggests that simple verbal expressions signifying substance, quantity, quality, relation, place, time, position, state, action, and affection are the categories. The doctrine implied may mean a classification of namable entities. It is argued, however, that at this stage "category" for Aristotle meant the ultimate type of predicate which is predicable of namable entities.

Whether Aristotle retained this definition is disclosed by an examination of the *Metaphysics*. Aristotle's usage there suggests that a category is a (1) predicate, though not clearly of ultimate type; (2) genus, both highest and proper; and (3) type of essential being.

Eleven other books by Aristotle reveal two points. First, the phenomena about category noted in the Categories and Metaphysics reappear. Instances may be seen of the definition of category in the Categories and of the three definitions in the Metaphysics. Secondly, no new phenomena appear. No other definition or full discussion of the above four are found.

Three evaluations follow. First, Aristotle's doctrine of category appears to have evolved in a manner neither completed nor described fully in his extant works. Secondly, Aristotle's statements about category are not very precise. Thirdly, Aristotle leaves questions unanswered about category, though ones which later thinkers found stimulating.

Kant does not mention the question of the definition of category in his pre-Critical period. He contends in the Inquiry of 1764, however, that definitions are to be introduced last in philosophy and not first as in mathematics.

In the semi-Critical period, the only document of importance is the Dissertation of 1770. It suggests that a category is an intellectual concept of non-sensory objects and relations.

The Transcendental Analytic in the Critique of Pure Reason is the main source of Kant's Critical definition of category. In the Analytic he designates a category most frequently as a "concept of understanding." Yet many other terms are used also. But so far as meaning is concerned, Kant defines a category in four major ways, namely, as a (1) function of judgment, (2) concept of necessary synthetic unity, (3) concept of pure synthesis, and (4) concept of an object in general.

Conclusions drawn are that (1) Kant's thought about category evolved and can be traced more easily than Aristotle's, (2) what Kant says about category is not so precise as desired, and (3) Kant raises many questions, such as (a) does Kant assume too narrow a definition of definition? and (b) does Kant imply two different ways of viewing the categories in defining them as functions and as concepts?

The third philosopher investigated is Borden Parker Bowne, pioneer American personalist who wrote frequently of the categories. Three of his books are of primary importance, namely, the Metaphysics of 1882, the Theory of Thought and Knowledge of 1897, and the revised Metaphysics of 1898.

The following points about Bowne's writing on category are substantiated: (1) the absence of any single, formal definition of category; (2) the presence of many varied terms with which Bowne speaks of the categories; and (3) his implied definition that a category is a type of mental activity in terms of which objects are constructed in thought.

Three evaluations of Bowne's position are offered. First, he was too loose in using terms to designate category. Secondly, Bowne's implied definition of category as type of mental activity shows the influence of Kant. Thirdly, Bowne does not offer sufficient support for his implied definition of category.

Microfilm \$4.80; Xerox \$16.90. 375 pages.

THE REALISM OF C. J. DUCASSE
AND J. B. PRATT:
A COMPARISON AND CRITIQUE.

(Order No. Mic 61-1102)

Ronald Ernest Santoni, Ph.D.
Boston University Graduate School, 1961

Major Professor: Dr. George Berry

The purpose of this dissertation is to inquire into the workings of the ostensibly similar philosophical positions of C. J. Ducasse and J. B. Pratt, to ascertain whether or not they actually are in fundamental agreement, and to determine the basis for any essential difference which a comparative analysis might show to exist between selected views of the two authors. Within the context of this investigation, the writer also intends to criticize and assess the general philosophical positions under scrutiny.

Each author claims an "empirical" view of philosophy: but while Ducasse uses "empirical" to designate a scientific methodology to which all philosophical inquiry must conform, Pratt uses "empirical" to characterize the philosophical position which finds its starting-place in personal experience.

In regard to the historical problems of Substance, Existence, Causality, and the Mind-Body relation, respectively, a number of fundamental contentions of the two authors appear to be in marked contrast. The question arises: What is the basis for these apparently fundamental disagreements between the two philosophers?

The writer submits the thesis that the apparent differences in the two sets of views can be traced to two essentially different "postures" or "universes of discourse" from which the two authors see and meet these problems. Framed within two different postures (semantical vs. experiential) of investigation, the two sets of hypotheses neither consider nor account for the same data, and, hence, neither talk about nor say the same thing.

Contrary to one's expectations, Ducasse and Pratt approach ethics and religion at the same level of language, address the same type of data, insist that their respective definitions are in accord with ordinary-language usage, and, in short, speak within the same posture of philosophical inquiry. Moreover, the two authors are, in each case, making many fundamentally similar contentions.

That is to say, there is general agreement in Ducasse and Pratt regarding the topics examined only where the two authors view, approach, and come to grips with the individual topics within the same universe of discourse; and where there is not this coincidence of philosophical postures, there is not general agreement.

In view of this correlation, the writer affirms that the fundamental differences between Ducasse and Pratt can be accounted for in terms of the essentially different postures which they assume in respect to many of the philosophical problems.

Two persistent criticisms of Ducasse's philosophical approach and one basic question concerning Pratt's are expressed in this dissertation. The author criticizes Ducasse for his failure to abide by his own proposed methodology, and for his practice of deducing inferences about the nature of things from an inquiry which is thoroughly semantical in intent, data, and scope. The latter procedure confounds universes of discourse and commits

the fallacy of "mixed postures." The writer questions Pratt's tendency to talk as though one can come to grips philosophically with one's immediate experience of the present. For, doesn't one's living experience--that is, the experience with which one is directly and momentarily acquainted--slide into the mediate and become lived as soon as one tries to come to grips with it, as soon as one tries to observe it, as soon as one tries to comment upon it? Microfilm \$4.20; Xerox \$14.85. 326 pages.

ACQUAINTANCE AND COMPLEX OBJECTS IN BERTRAND RUSSELL'S EARLY WORK

(Order No. 61-3175)

Sid B. Thomas, Jr., Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor W. H. Hay

In the period 1905-1914, Russell maintained (a) that acquaintance is a two-term relation which holds, at times, between a 'subject' and an 'object'; and (b) that some objects of this relation are complex. If a complex object of acquaintance is understood as that which is expressed by a sentence, i.e., as the sort of thing Russell later called a fact, then these positions require acquaintance to be what is known as a pseudo-relation. The logic of *Principia Mathematica*, to which Russell would most naturally be taken as alluding, in calling acquaintance a two-term relation, admits no pseudo-relations. This dissertation attempts to elucidate these apparently conflicting elements of Russell's early work.

The second section, following a statement of the problem, discusses two reasons why Russell insisted upon the dual-relation view of acquaintance: he wished to ensure a distinction between the psychical subject (or act--he largely identifies these notions) and the non-psychical object; and he wishes to ensure a distinction between a knowledge of things, which is incapable of being erroneous, and a knowledge of truths, which is discursive. It is argued that the latter motive, while sound, is not accomplished by his way of construing the difference between the two types of cognition. Next, an attempt is made to distinguish two senses of the dichotomy particular-universal. One sense contrasts particulars, as objects of acquaintance, with universals, as acts of judging or asserting something about the objects; the other sense contrasts particulars, as constituents of objects of acquaintance, with universals as characters exemplified by them, such characters also being constituents of the objects of acquaintance. This is relevant because Russell, it is argued, regards complex sense-data as particular existents without making the distinction. The fourth section takes up the question of what is to be understood by the notion of a complex sense-datum. Finally, the fifth section notes that in 1914 Russell apparently became aware of the above mentioned difficulty in his view of acquaintance, and a discussion is given of his solution to it. That solution consists in restricting acquaintance to a way of knowing objects that can be named, and in substituting perception for the way of knowing certain objects (facts) which can only be asserted.

The Introduction and Concluding Remarks set the inquiry in its larger perspective. The main problem in theory of knowledge to which it is relevant is the distinction common sense recognizes between seeing something and thinking about it. In Russell's early work, when acquaintance with complex objects is admitted, this distinction appears as a distinction between immediate and mediated cognition. In his later work, when he has become convinced that facts cannot be named, but only asserted, such a statement of the distinction is not open to him. Microfilm \$2.75; Xerox \$5.40. 110 pages.

A LOGICAL AND EPISTEMOLOGICAL CRITIQUE OF CONTEMPORARY NOMINALISM WITH REGARD TO THE PROBLEM OF UNIVERSALS

(Order No. Mic 61-1458)

William Stephen Turner III, Ph.D.
Emory University, 1960

Director: Richard B. O'R. Hocking

It is the conclusion of this essay that contemporary nominalism has so far failed to provide an alternative to platonism. The ancient problem of universals has again come to the fore, mainly because of the recent debates concerning the foundations of mathematics. Here the problem of universals has received a new foundation and development. It is in this context that the problem of universals is examined in this essay and the new nominalism is criticized. In addition the new nominalism is considered from the point of view of its treatment of empirical questions.

There is in this paper a development of both the nominalists' criticisms of platonism and the proposed nominalistic alternatives to platonism. In regard to the foundations of mathematics, three different theses are defended by most nominalists. The first thesis is a rejection of all languages which quantify irreducibly over classes and similar abstract objects. The second thesis is a denial of an axiom of infinity or its equivalent. The second thesis is not held by all nominalists. The third generally held thesis is that the world is composed only of "concrete individuals." These three tenets characterize contemporary nominalism.

Contemporary platonism denies all three of these nominalistic theses. A platonist endorses languages which irreducibly quantify over classes and similar abstract objects. He accepts an axiom of infinity or its equivalent as being necessary for mathematics. And finally, he does not deny the existence of concrete individuals but does deny that these exhaust the constituents of the world. Thus platonism and nominalism sharply disagree on certain quite fundamental issues.

The nominalists' criticisms of platonism are based upon several different issues. It is asserted that platonism is mistaken as is shown by the paradoxes of classes, and the *ad hoc* and unintuitive means used to treat these paradoxes. Also any axiom of infinity is rejected because they feel that such an axiom would require basing mathematics on there being a physical hypothesis which asserted an

infinity of concrete objects. Furthermore, it is claimed that they have a basic intuition which shows them that there are only concrete objects. In order to provide an alternative to platonism, these nominalists attempt to construct a satisfactory nominalistic object language, syntax, and semantics for mathematics. These alternatives are examined in the essay.

On the contrary, the platonist can claim a basic intuition that there is more to the world than concrete individuals. The platonist notes that, unlike the nominalist, he need not assert an infinity of concrete individuals in order to provide for the number system since he, the platonist, has classes, classes of classes, etc. Furthermore, the nominalistic criticisms based on the paradoxes have been overstressed. The platonist can point out that he can provide alternatives to naive class theory which avoid the paradoxes and which are not very artificial.

However, the main burden of the defense of platonism naturally rests upon showing that nominalism cannot provide an acceptable alternative. The platonist notes that

the nominalistic constructions are very complex and artificial. In addition, he notes that the nominalist is unable to provide a general basis for the "ancestor" relation. The most serious objection to nominalism is that it cannot provide a basis for the generally accepted portions of mathematics, and platonism can provide such a foundation.

In regard to empirical languages and the problem of universals the issue hinges upon the question of whether or not the nominalist can provide a reasonable and adequate alternative to platonism. The alternatives proposed by the nominalists are usually founded upon some version of a theory based on "resemblance." In this essay it is shown that resemblance theories are inadequate because they are unable to solve the problem posed by "resemblance in what respect" and the problems posed by relations. Thus the platonist rejects the alternatives posed by the nominalists to a platonic approach.

Microfilm \$2.95; Xerox \$10.35. 228 pages.

PHYSICS

PHYSICS, GENERAL

THE PRIMARY COSMIC-RAY ALPHA PARTICLE ENERGY SPECTRUM IN TEXAS AT A TIME NEAR SOLAR MAXIMUM

(Order No. Mic 61-1904)

Donald Eugene Guss, Ph.D.
Washington University, 1961

Chairman: Michael W. Friedlander

From the analysis of an emulsion stack exposed to the primary cosmic radiation over Texas on February 8, 1959, a time near solar maximum, the alpha particle integral energy spectrum was found to be well represented by a simple power law of the form

$$N(W) = CW^{-\gamma}$$

in the kinetic energy range 2.5-7.5 Bev/nucleon. The value of exponent was found by the method of maximum likelihood to be $\gamma = 1.48^{+0.17}_{-0.14}$, which is not appreciably different, but, perhaps, somewhat lower than a value $1.61^{+0.29}_{-0.26}$ found at solar minimum in the kinetic energy range 1.8-3 Bev/nucleon by a similar technique. A slightly smaller exponent at solar maximum is consistent with a solar modulating mechanism which preferentially removes low energy particles from the primary cosmic ray spectrum. Though these emulsions were not exposed right at the solar maximum, they were exposed at a time near solar maximum, and the result does not seem consistent with a value $\gamma = 1.0$ in this energy range at solar maximum, as has been suggested.

Previously, Coulomb scattering measurements of alpha particle tracks in emulsion have been used only out to alpha particle kinetic energies of 3 Bev/nucleon. By using glass-backed plates and a low temperature isothermal processing technique, the emulsion noise was reduced to a level where measurements could be extended to alpha particle kinetic energies of 7.5 Bev/nucleon. A check of the point on the integral spectrum at a kinetic energy of 7 Bev/nucleon with flux values found at Guam during a period of similar cosmic ray intensity shows that there is no significant noise contribution in these emulsions which varies with cell size in the same way as the Coulomb scattering signal.

Microfilm \$2.75; Xerox \$5.60. 112 pages.

THE INFRARED SPECTRA OF SINGLE CRYSTALS OF COMPOUNDS WITH LONG METHYLENE CHAINS

(Order No. 61-3023)

Redus Foy Holland, Ph.D.
The University of Oklahoma, 1961

Major Professor: J. Rud Nielsen

The following crystals were grown: Triclinic $n\text{-C}_{18}\text{H}_{38}$, orthorhombic $n\text{-C}_{24}\text{H}_{50}$, monoclinic $n\text{-C}_{36}\text{H}_{74}$, C-forms of $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$, $\text{CH}_3(\text{CH}_2)_{16}\text{COOD}$, and $\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$, B-forms of $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$ and $\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$, A-forms of $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$ and $\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$, and crystals of $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$, $\text{CH}_3(\text{CH}_2)_{16}\text{COOD}$, and $\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$ of a new type, here called the E-form.

The crystals of $n\text{-C}_{36}\text{H}_{74}$ are twinned or polytypic and behave optically like orthorhombic crystals. The E-form crystals are apparently monoclinic, with chains arranged as in the B-form, but with a molecular configuration similar to that in the C-form.

The infrared spectra of single crystals were obtained with linearly polarized radiation incident upon crystal faces or upon slices cut from the crystal. In crystals having more than one molecule per unit cell the splitting of fundamentals into components of different polarization was observed with radiation incident normal to the crystal faces. Spectra of triclinic crystals obtained in a similar manner allowed a distinction, not made previously, between vibrations parallel and perpendicular to the planes of the carbon skeletons of the methylene chains. The spectra of crystal slices permit a distinction between vibrations parallel and perpendicular to the chain axes.

The observed spectra have been interpreted in detail. Several assignments of fundamentals of these or similar crystals made by previous workers have been confirmed and extended; others have been revised or disproved.

Bands of the CH_2 rocking series, extending from 720 to near 1000 cm^{-1} , are polarized perpendicular to the chain axes. In the n -fatty acids, all are infrared-active. The polarization and splitting of rocking doublets vary with the crystal form. This has been related to the crystal structure by considering a simple model. Results indicate that interactions between next-nearest CH_2 groups in adjacent chains are as great as between neighboring groups.

In $n\text{-C}_{18}\text{H}_{38}$, CH_2 wagging and twisting vibrations can be differentiated by their polarization. The observed limits of the wagging series are at 1185 and 1395 cm^{-1} . Bands ascribed to CH_2 twisting lie between 1179 and 1301 cm^{-1} . Wagging series in the other n -paraffins have also been identified. Series in this region in the spectra of the acids have been interpreted as CH_2 wagging coupled with a carboxyl vibration.

Assignments of CH_2 and CH_3 deformation and stretching and skeletal stretching vibrations generally conform to those made by previous workers. Changes in, or choices between, previous assignments have been made for bands near 890 cm^{-1} ascribed to CH_3 in-plane rocking, doublets near $1368\text{--}1378\text{ cm}^{-1}$ in monoclinic crystals attributed to CH_3 symmetric deformation, and a band at 2898 cm^{-1} interpreted as a combination.

Assignments of the carboxyl vibrations are consistent with previous work. There is evidence of interaction with wagging, rocking, and skeletal vibrations which affects both polarizations and intensities. In B-form crystals there appears to be strong mechanical coupling between carboxyl and chain vibrations.

Microfilm \$2.75; Xerox \$8.20. 179 pages.

A SEARCH FOR A MASS 550 PARTICLE

(Order No. Mic 61-1908)

George Monnig, Ph.D.
Washington University, 1961

Chairman: Robert D. Sard

An experiment has been carried out at sea level to search for a mass 550 particle. The mass of particles stopping in a range interval 115 to 205 gm/cm^2 Pb equivalent below the outside air was determined simultaneously by two methods, one employing range and momentum, the other range and Cerenkov light. Range was measured in 13 Pb. plates hodoscoped by Geiger Counters; momentum was measured in a magnet cloud chamber; and Cerenkov light was measured in a cell containing a liquid with an index of refraction of 1.27. The Cerenkov light of a mass 550 particle and a light meson differ by a factor of at least two over the range interval.

The combination of two methods of mass measurement affords protection against the possibility that an occasional large error in the "ionization range" causes erroneous resolved mass determinations. This is an important source of error due to the large number of penetrating particles relative to stopping particles and also the possibility of a stopping due to a nuclear interaction.

In 519 stopping events for which Cerenkov light was recorded, no resolved mass 550 measurement was obtained. It is estimated that if a mass 550 particle had stopped, the likelihood of its having the appearance of one of the observed events depends on the point of stopping but is always less than 10%.

No information is provided by a group of 29 events for which no Cerenkov light was recorded, since the precision of mass measurement using only range and momentum is insufficient to resolve a possible mass 550 particle from protons. The range interval available for detection of mass 550 particles is therefore only that for which they are expected to produce Cerenkov light, 89 to 163 gm/cm^2 Pb. equivalent below the air outside. The number of light mesons stopping in this interval is 448. Allowing for the counting bias in favor of mass 550 particles, which are deflected less in the magnetic field than light mesons, the corrected number of light meson stoppings unaccompanied by a mass 550 particle is 471.

Microfilm \$2.75; Xerox \$9.25. 203 pages.

MOMENTUM TRANSFER TO A SMALL PARTICLE BY A PULSED PLASMA

(Order No. 61-3586)

Sidney Ross, Ph.D.
Temple University, 1961

At reduced pressures, in the region from 40 to 100 microns Hg, an electrical conductor, when exploded by the discharge surge of current from a charged capacitor can be accelerated in a plasma cloud to drift velocities. This cloud, passing over a stationary macroscopic particle, acts as a Maxwellian gas and accelerates the mass by a drag mechanism.

An analysis of the drag due to the injected mass flow evolves a momentum transfer function of the form

$$P = \frac{V_p}{\frac{2}{C_D} \frac{A_p}{A} \cdot \frac{1}{M_p} + \frac{1}{M}}$$

where P is momentum transferred

V_p is plasmoid velocity

A_p is plasma channel area

M_p is injected plasma mass

A is particle area

M is particle mass

C_D is drag coefficient

A precision method is developed for measuring the injected mass of plasma derived from an electrically exploded metal. This method is applied to a number of conductors of varied material and geometric configuration.

An analysis of a drag pendulum shows that if a simple bob is to be used, the dimensions which permit it to be smaller than the flow area, and hence retain the drag validity, preclude its mass from being sufficient for the gravitational force to be of the same order as the drag force. As a result, such a simple pendulum, if accelerated, will not be useful for impulse measurements. This is experimentally confirmed.

Photographic studies of the exploding metal show that plasma derived from sections of the conductor, where the entire conductor is not vaporized, is magnetohydrodynamically driven by the accelerator and injected as a plasmoid. This mass is deposited in a manner similar to the mass of a fully vaporized conductor. In both cases the mass was determinable without resorting to the approximation of a uniform constant plasmoid density.

In the direct mass determinations, glass collectors were used to facilitate the measurements before and after the firings. No evidence of pitting or ablation was found; weights prior to firing and after removal of the deposited mass were identical, to the precision of a micro gram balance. A particle momentum detector was constructed and calibrated in the range of predicted transferred momentum. Signals from firings with pellets were not significantly different from those without pellets; the signal output of the pellet was either masked by the momentum imparted by the impacting plasma, or the pellet missed the plate. Slower more ponderous debris such as liquid metal droplets are detectable by this apparatus.

Direct high speed motion picture photography studies were conducted of the pellet motion. These were necessary to determine the nature and velocity of accelerated macroscopic particles. Experimental data obtained in this manner of momentum transfer from the plasma to 1 mm spherical steel and glass pellets agreed closely with theoretically predicted momentum transfer using experimentally determined injected mass data.

Microfilm \$2.75; Xerox \$4.20. 76 pages.

PHYSICS, ELECTRONICS AND ELECTRICITY

INVESTIGATION OF THE SCATTERING OF ELECTROMAGNETIC ENERGY FROM SPHERES IN THE CRITICAL SIZE REGION

(Order No. 61-3578)

Simpson Beral Adler, Ph.D.
Temple University, 1961

This dissertation has been concerned with the investigation of the scattering of electromagnetic energy from single spheres whose sizes are in the order of the incident wavelength. Of primary interest has been the experimental verification of Mie's theory using a pulsed radar to measure the backscattering from metal and dielectric spheres. Experiments were performed in the region $0.74 \leq 2\pi\gamma/\lambda \leq 4.6$ in the 5400-5900 mcs/sec frequency band. Measurements were made on fifty-three aluminum spheres, forty teflon spheres, twelve lucite spheres, and twelve bakelite spheres which were suspended in free space (air).

Recursion formulas for the scattering of a plane electromagnetic wave by a sphere were derived theoretically and are useful generally for dielectric as well as for totally reflecting spheres. These formulas were used to obtain digital computer solutions for teflon, lucite, bakelite and totally reflecting spheres. The solutions are given in the form of tables and graphs.

A hitherto unnoticed phenomenon was recorded pertaining to the resonance mechanism. The data shows a complicated beat pattern in the backscattered wave which is attributed to interference from multiple electromagnetic sources in the vicinity of the resonant sphere, and which may be related to the theory of surface waves. It has also been shown that the radar may be used as a probe to measure the diffraction by a sphere in the radar's coordinate system. Microfilm \$2.75; Xerox \$8.80. 191 pages.

EXPERIMENTAL AND THEORETICAL INVESTIGATIONS OF THE SECONDARY ELECTRON EMISSION PHASE ANGLE DISTRIBUTIONS IN A LOW PRESSURE MULTIPACTING ELECTRICAL DISCHARGE

(Order No. 61-3020)

August Miller, Ph.D.
New Mexico State University, 1961

Supervisor: Otto Theimer

Experimental and theoretical investigations of the multipacting electrical discharge have been carried out for the purpose of extending the knowledge of the electron phase angle distributions found within the discharge. The theoretical studies included the development of a high speed computer program for calculation of the electron emission phase angle distributions by a method of successive approximations. The results of those calculations are compared to those obtained by earlier investigators who used several questionable assumptions. The experimental investigations have resulted in the reporting of a

new phenomenon occurring within the multipacting discharge, as well as the experimentally determined properties of that phenomenon. Some discussions of the possible origin of the phenomenon are included.

Microfilm \$2.75; Xerox \$5.80. 119 pages.

PHYSICS, NUCLEAR

NUCLEAR RESONANT ABSORPTION OF GAMMA RADIATION BY CALCIUM-40

(Order No. 61-3300)

Alan Christian Eckert, Jr., Ph.D.
Case Institute of Technology, 1961

Ground state gamma rays ($E_\gamma = 10.3$ mev.) emitted by excited Ca^{40} formed in the reaction $\text{K}^{39}(\text{p}, \gamma) \text{Ca}^{40}$ at $E_p = 2.05$ mev. have been resonantly absorbed in calcium. Nuclear resonant absorption occurs when the absorber is placed at such an angle that the loss in energy upon emission and absorption of the gamma rays is restored by the Doppler shift resulting from the recoil velocity of the excited Ca^{40} nucleus. The gamma radiation which is transmitted by the calcium absorber is passed through a collimator slit and detected by a scintillation detector. For the thickest absorber used the nuclear resonant absorption curve, inferred by observing the transmission through the absorber as the collimator is rotated through the resonant angle, has a peak absorption of 44 per cent and a width of 0.8 degrees. The width is determined by the angular divergence of the proton beam and the angular opening of the collimator. From the integral of the absorption as a function of angle and from a yield measurement, the radiation width for a transition to the ground state is determined to be 3.6 ± 0.24 ev., while 5.8 ± 1.8 ev. is found for the proton width, and 10.3 ± 1.7 for the total width. These values together with the measured angular distribution of the ground state radiation are consistent with a 2^+ assignment to the resonance level.

Microfilm \$2.75; Xerox \$3.60. 63 pages.

STRUCTURE OF LOW-LYING LEVELS OF Li^6

(Order No. 61-3302)

William F. Ford, Ph.D.
Case Institute of Technology, 1961

The ground state and the 3.56 Mev $J = 0$ level of Li^6 are investigated by means of the resonating group technique, using the variational principle. The nucleus is visualized as a loosely coupled system consisting of an alpha particle core plus two orbital nucleons. That part of the wave function which describes the motion of the orbital nucleons relative to each other and to the core is chosen so that any amount of correlation is possible, from the extreme shell model to the extreme alpha-deuteron model.

Most of the calculations are done using a central two-body interaction which has been shown to fit the nucleon-alpha scattering data. With equal parts of ordinary and space exchange force, -30.8 Mev is obtained for the binding energy and 4.45 Mev for the $J = 0$ level excitation energy. Other exchange mixtures and force strengths are also investigated.

The assumptions underlying the model are found to be justified; in particular, correlation is pronounced, and the level splitting arises primarily from mutual interaction of the two orbital nucleons. The latter point is further substantiated by an approximate calculation using tensor and spin-orbit forces.

Microfilm \$2.75; Xerox \$4.20. 77 pages.

GAMMA RAY ATTENUATION COEFFICIENTS FOR HELIUM FROM 5 MEV TO 19 MEV

(Order No. 61-3304)

David Harrison Green, Ph.D.
Case Institute of Technology, 1961

The gamma ray attenuation coefficients for helium from 5 Mev to 19 Mev were measured using liquid helium. The coefficients obtained in the lower energy range were significantly larger than predicted by theory.

Microfilm \$2.75; Xerox \$3.60. 64 pages.

ELECTRODISINTEGRATION OF H^3 AND He^3

(Order No. 61-3305)

Ronald McClure Haybron, Ph.D.
Case Institute of Technology, 1961

The inelastic scattering cross-sections for high energy electrons on H^3 and He^3 were calculated using the Born approximation for the motion of the electrons and disintegration products. The ground state wave functions for the nuclei were taken to be Gaussians in the inter-particle separations.

The predominate reaction for both nuclei was found to be a complete disintegration, where the cross-section is expressible as a sum of the elastic scattering cross-sections for the individual nucleons multiplied by a factor determined by the structure of the nuclear wave functions.

An estimate of the effects of the final state interactions between the nucleons produced a reduction of the uncorrected peak cross-section in the neighborhood of 20%.

Microfilm \$2.75; Xerox \$3.00. 56 pages.

A STUDY OF THE SCATTERING OF
ACCELERATOR PRODUCED
2.0 BEV/C MU-MESONS BY CARBON AND LEAD

(Order No. Mic 61-2099)

Leslie David Heggie, Ph.D.
University of Washington, 1961

Chairman: Professor George E. Masek

The scattering cross section of high energy mu-mesons in carbon has been measured, using a pure, monoenergetic beam of muons obtained with the Bevatron at the Lawrence Radiation Laboratory. Preparation, purification, and measurement of the properties of the beam are described. The median momentum was 2.00 ± 0.03 BeV/c, the spread in momentum was not more than $\pm 3.5\%$, and the effective contamination due to pions was 4.9×10^{-6} . During the experiment the total number of muons incident on the apparatus was 2.5×10^7 . A counter hodoscope recorded the muons scattered from 14.4 g/cm^2 of lead and from 27 g/cm^2 of carbon. Inelastic as well as elastic processes were accepted. Scattered particles were observed at angles up to 12° (momentum transfer $\sim 400 \text{ MeV/c}$). The lead data cover the same range as those cosmic ray experiments which have appeared to indicate an anomalously large scattering. No anomaly is found; the lead scattering agrees closely with the distribution calculated by Cooper and Rainwater for purely electromagnetic interactions. The carbon data permit a better comparison with theoretical expectations, since one is measuring the single-scattering cross section directly, and one can account for the effects of nuclear structure rather accurately, using electron-scattering data and a detailed theoretical analysis of Drell and Schwartz. The carbon scattering results, based on 300 events in the region $70 \text{ MeV/c} - 400 \text{ MeV/c}$ momentum transfer, agree closely with the Drell-Schwartz theory. The upper limits which this result places on a non-electromagnetic scattering cross section and on a muon form factor are discussed.

Microfilm \$3.70; Xerox \$13.05. 286 pages.

A LOW RESOLUTION SURVEY OF
(d, α) REACTIONS IN HEAVY NUCLEI

(Order No. 61-3270)

James Barry Mead, Ph.D.
University of Pittsburgh, 1961

Supervisor: Bernard L. Cohen

A low resolution survey of (d, α) reactions was made for about 25 heavy nuclei between $Z=28$ and $Z=82$ with an incident deuteron energy of 15 MeV. Energy distributions and cross sections were obtained at scattering angles of 30° , 60° , 90° and 120° using a scintillator-proportional counter telescope.

In general, the energy spectra are characterized by two strong peaks which vary slowly and regularly in energy and cross section with atomic number. From a study of the angular distributions of these peaks, it was concluded that the low energy group is predominantly a compound

nucleus effect, and that the high energy peak is the result of a direct interaction mechanism.

Energy spectra and cross sections for the low energy peak were found to be in good agreement with the predictions of statistical theory. Although statistical model parameters extracted from the energy spectra disagreed somewhat with previous data, the presence of direct interactions or multiple evaporations can possibly account for this discrepancy.

Most of the features of the high energy peak can be explained by the assumption of a process which involves the pick-up of a proton and neutron from separate single particle states. Arguments which support the assignment of a double pick-up process to the high energy peak are presented. Microfilm \$2.75; Xerox \$4.20. 80 pages.

POLARIZATION OF
PROTONS SCATTERED FROM CARBON

(Order No. 61-3627)

Samuel Jack Moss, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor W. Haeberli

The polarization of protons elastically scattered from C^{12} has been measured in 10-degree intervals for laboratory scattering angles from 20° to 140° at eight energies between 4.7 and 8.7 MeV. Protons scattered by self-supporting carbon targets (150-200 kev thick) entered a helium cell. The left-right asymmetry of the doubly scattered protons was measured with junction detectors at a mean second scattering angle of 125° . The analyzing power of helium was taken from Brockman.¹ The angular distribution of polarization at 6.2 MeV is characterized by a maximum at 70° ($P = +.92 \pm .08$) and minima at 40° ($P = -.83 \pm .01$) and 100° ($P = -.70 \pm .05$) where P is taken

positive in the direction $\vec{k}_{in} \times \vec{k}_{out}$. As the energy is increased the forward angle minimum decreases in absolute value while the back angle minimum increases. The maximum is above $P = +.70$ at all energies measure.

The polarization as a function of energy was measured at a laboratory angle of 50° from 4.3 to 9.2 MeV in steps of 250 kev using target thicknesses ranging from 100-160 kev. Agreement with other measurements at 7 MeV² and 8 MeV³ is good.

For the purpose of carrying out a phase shift analysis differential elastic cross sections were measured at the same energies as the polarization. On the basis of the analysis an assignment of $3/2^+$ was made to the broad resonance in the carbon cross section around 6.5 MeV proton energy. This is in agreement with the assignments of Dearnaley⁴ and of Schneider⁵ from differential cross section measurements.

1. K. Brockman, Phys. Rev. 110, (1958), 163.
2. J. E. Evans, Proceedings of the Symposium on Polarization Phenomena, Basel, 1960, (to be published).
3. L. Rosen, Proceedings of the International Conference on Nuclear Structure, University of Toronto Press, 1960.

4. G. Dearnaley (private communication).
5. H. Schneider, *Helv. Phys. Acta* 29, (1956), 55.
Microfilm \$2.75; Xerox \$5.20. 101 pages.

**LIFETIME STUDIES OF PHOSPHORESCENCE
IN AROMATIC COMPOUNDS
UNDER VARIOUS CONDITIONS
AT LOW TEMPERATURES**

(Order No. 61-2925)

Dolores Urquiza Olness, Ph.D.
Duke University, 1961

Supervisor: Hertha Sponer

Decay curves of the triplet-singlet emission from naphthalene, hexamethylbenzene, and durene in the crystal-line phase have been studied under various conditions of crystal formation and in the presence of different gases, at temperatures of 4.2°K and higher. Rigid glass solutions of these compounds at 77°K and a mixed crystal of naphthalene in durene at 4.2°K and 77°K have also been studied. The decay from the crystalline samples did not obey an exponential law at any temperature studied. Crystalline durene was found to have two lifetimes, one on the order of seconds and the other on the order of tens of milliseconds. The longer-lived decay is interpreted as the true durene decay and the short-lived as that of an oxidation product of durene, which was produced photochemically and excited by sensitization. In general, the later portions of the decay curves from all of the substances were nearly exponential. When the mean half-life measured in these later portions was plotted as a function of temperature, the lifetime was found to decrease with increasing temperature as $\log 1/T$, throughout the temperature region studied. Decay curves from all of the solutions studied at 77°K were found to be exponential in cases where a true glass was formed. Over the range of concentrations studied the decay times were found to either remain constant or to decrease with increasing concentration. The emission from the mixed crystal of naphthalene in durene consisted of two parts, a short-lived decay from the durene oxidation product and a longer-lived exponential decay from naphthalene. Various theories concerning the causes of the non-exponential decay and the change in the general shape of the decay curves with temperature are discussed. It is suggested that the inhomogeneous magnetic field produced by neighboring triplet molecules is partially responsible for the non-exponential decay; this theory was first proposed by M. Kasha in 1947. However, it appears that the effect is too great to be explained by this mechanism alone, and that purely crystalline phenomena are also very important in determining the type of decay. A discussion of some of these crystal phenomena is included.

Microfilm \$2.75; Xerox \$5.20. 103 pages.

**THE DISINTEGRATION CROSS SECTIONS
OF NEON AND KRYPTON
FOR FAST NEUTRONS**

(Order No. 61-3628)

Robert Eugene Shamu, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor H. H. Barschall

A high-pressure gas scintillation counter filled with neon or krypton was used to measure their disintegration cross sections for fast neutrons. The $D(d,n)He^3$ reaction served as the source of neutrons. Neutron flux measurements were made with a proton recoil counter telescope. For neon, disintegration cross sections were measured from 6.2 to 10.7 MeV neutron energy with a neutron energy spread of about 60 keV. Partial cross sections were measured for the reaction $Ne^{20}(n,\alpha)O^{17}$ for which the residual nucleus was left in its ground state, first excited state, second excited state, and third excited state, respectively. Sharp peaks in these partial cross sections yielded information about the energy levels of Ne^{21} . The total disintegration cross section of neon was measured from 6.2 to 9.1 MeV neutron energy. For krypton, the cross section for disintegration by charged particle emission increased monotonically from 5 mb at 6.4 MeV to 25 mb at 12 MeV neutron energy. Evidence is given that the krypton disintegrations correspond primarily to (n,p) reactions for this neutron energy range.

Microfilm \$2.75; Xerox \$3.80. 66 pages.

**SOME ASPECTS OF THE INTERACTION
OF ELECTROMAGNETIC RADIATION
WITH MANY PARTICLE SYSTEMS**

(Order No. Mic 61-2072)

Narkis Tzoar, Ph.D.
University of Pennsylvania, 1961

Supervisor: Abraham Klein

The first part of this work is a study of the process of electromagnetic absorption by an electron gas, to the lowest order in the external field. The resulting cross section is expressed in terms of the two particle Green's Function for the system. Since this cannot be computed exactly, a discussion of the high density approximation is considered.

In pursuing the investigation, it is first seen that the process in which a photon gives rise to a single plasmon (the random phase approximation) does not contribute since the plasmon is a longitudinal mode of vibration and as such the transverse photon does not couple directly to it. The next approximation describes the virtual creation of a pair by absorption of a photon, which decays to the final state of pair plus plasmon. In this process one must include scattering matrix elements for the electrons. The process considered does not give rise to a narrow absorption line inasmuch as for any plasmon there are many pair states in the electron gas, which together with the plasmon will conserve energy and momentum in the absorption of a photon. One finds, rather, a peak of finite width in the

cross section even in the approximation that considers the plasmon as a bound state of the system. The cross section calculated in this work is of the order of $10^{-17} - 10^{-19} \text{ cm}^2$ per electron for real metals and therefore should be detectable experimentally.

The second part of this work considers two models for calculating the resonance energy in dipole absorption in nuclei. In one of them the nucleus is approximated by infinite nuclear matter, and the interaction between the nucleons is approximated by those terms which give rise to a plasmon like bound state, which is coupled to the electromagnetic field. This model is called the "Long Range Model." Two objections to this model are pointed out. First, since the nucleon-nucleon potential is short range there is a question about the validity of the plasmon like bound state. Second, there is objection to the use of nuclear matter at all as a model for obtaining the giant dipole state, since the nature of the state is sensitive to the single particle spectrum, which is so vastly different for infinite nuclear matter and for finite nuclei.

Consideration is then turned to the Short Range Model. Here one assumes for the unperturbed states the Harmonic Oscillator Shell Model Wave Functions. One next approximates the interaction between nucleons by the terms which give only a particle-hole interaction in the ladder approximation. This gives rise to the dipole bound state of Brown and Bolsterli due to the high degeneracy of the unperturbed dipole levels. One must understand the above model in the sense of a new version of standard shell model calculations, where the two body interaction is in effect some effective potential which accounts for the missing terms in the approximated Hamiltonian.

Using this philosophy one can incorporate phenomenologically the lifetime of the dipole state which relates to the width of the absorption cross section. It is shown that the total width is composed of the unperturbed single particle width plus interaction width. The last part results from a complex effective potential which is responsible for the indirect process in the γ -ray absorption. The results are compared with previous calculations as well as with the experimental results.

Microfilm \$2.75; Xerox \$5.60. 115 pages.

ANGULAR DISTRIBUTIONS OF SOME SELECTED FISSION FRAGMENTS

(Order No. Mic 61-2106)

Richard Enos Wilson, Ph.D.
University of Washington, 1961

Chairman: Arthur W. Fairhall

The angular anisotropies for specific fragments from the fission of lead and thorium with 43 Mev helium ions were measured. In the case of lead, species with mass ratios greater than 1.23 have a constant anisotropy of 2.0. As the mass ratio decreases the anisotropy increases to a value of 8 for Ru^{105} . The data were interpreted to mean that the increase in the anisotropy was due to second chance fission. The anisotropy of the second chance fission was greater than 8 and the mass yield had a full width at half maximum value of about ten mass units. The

threshold for fission was found to be 21 Mev, in good agreement with the values reported by Nicholson, and the ratio of first to second chance fission was 4/1 which agrees well with the value reported by Neuzil.

The curve for the anisotropy of thorium as a function of the mass ratio of the fission fragments is constant at 1.5 for mass ratios less than 1.75 and rises for mass ratios greater than 1.75. The flat portion of the curve is due mainly to a mixture of first, second, and third chance fission. The rise in the anisotropy for mass ratios greater than 1.75 is due to the increase in the relative yield of fourth chance fission. The relative yield of 20% fourth chance fission is in reasonable agreement with semi-theoretical calculations.

Microfilm \$2.75; Xerox \$5.40. 108 pages.

NEUTRONS FROM $p + T$ AND $D + D$

(Order No. 61-3629)

Walter Ervin Wilson, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor H. H. Barschall

Differential cross sections for the reactions $D(d,n)\text{He}^3$, $D(d,np)D$ and $T(p,n)\text{He}^3$ were measured for bombarding energies of 5 to 13 MeV. Targets containing gaseous deuterium or tritium were bombarded with deuterons or protons from a tandem electrostatic accelerator.

The zero-degree differential cross section of $D(d,n)\text{He}^3$ was measured with a recoil proton counter telescope at intervals of 0.5 MeV from 4.8 to 13.3 MeV. The cross section was found to increase from a value of about 80 mb/steradian at 5 MeV to 100 mb/steradian near 10 MeV and then remain essentially constant to the highest energy measured.

Differential energy spectra of the neutrons at zero degrees from the tertiary process $D(d,np)D$ were obtained with the telescope for deuteron energies of 9, 10, 11 and 13 MeV. These spectra were integrated to obtain the differential cross section for breakup neutrons of all energies. The yield increases rapidly with energy so that above 9.5 MeV more breakup than monoenergetic neutrons are produced by $D + D$. At 13 MeV the breakup differential cross section approaches 190 mb/steradian.

The zero-degree differential cross section of the $T(p,n)\text{He}^3$ reaction was measured with the telescope at about 0.5 MeV intervals from 5 to 13.5 MeV. Since the purity of the tritium target gas was unknown, the measurements were relative ones and absolute cross sections were obtained by normalization to other measurements in the region of overlap. The differential cross section at zero degrees decreases from a value of 67 mb/steradian at 5 MeV to a minimum of about 26 mb/steradian at 9.5 MeV and then increases to 36 mb/steradian at 13.5 MeV.

Relative angular distributions of the neutrons from the $T(p,n)\text{He}^3$ reaction were obtained at about 0.5 MeV intervals from 5 to 13 MeV proton energy. Absolute cross sections were obtained by normalization to the zero-degree telescope measurements. Measurements were made at 10° intervals up to a maximum angle between incident proton and emerging neutron of 150° in the

laboratory frame of reference. A stilbene scintillator was used as the neutron detector for the relative angular distribution measurements.

The distributions, when transformed to the center-of-mass system, are strongly peaked in the backward hemisphere. At 7 MeV a broad maximum appears at about 65° in the angular distributions which implies the presence of d-wave neutrons. The center-of-mass distributions were fitted with a Legendre series expansion and the total reaction cross section obtained from the coefficients.

Microfilm \$2.75; Xerox \$4.00. 72 pages.

PHYSICS, SOLID STATE

GROWTH AND INVESTIGATION OF FERROELECTRIC CADMIUM NIOBATE SINGLE CRYSTALS

(Order No. Mic 61-2177)

Melvin Leroy Charters, Ph.D.
Rutgers University, 1961

Major Professor: Dr. John H. Koenig

Cadmium niobate monocrystals were prepared by a modified Stockbarger method. These crystals and polycrystalline ceramics were used to investigate the paraelectric properties between -65°C and the first ferroelectric Curie temperature and the ferroelectric properties to liquid nitrogen temperatures. The dielectric constant in the (110) direction was found to increase remarkably in the vicinity of the second ferroelectric Curie temperature. Devonshire's theory of ferroelectricity is used in the formulation of a technique where by the free energy of polarization as a function of temperature, in the region of the first ferroelectric transition, can be obtained by dielectric measurements alone. Different dc fields are used to bias the specimen while ac fields are used to measure the dielectric constant as a function of temperature. Errors associated in practical measurements are discussed. Low temperature X-ray and microscopic observations could not supply any further new evidence on the nature of the first ferroelectric transition in cadmium niobate.

Microfilm \$2.75; Xerox \$5.80. 119 pages.

EFFECTS OF CRYSTALLOGRAPHIC TRANSFORMATIONS ON THE PHOTOELECTRIC EMISSION FROM URANIUM

(Order No. 61-3011)

Richard Kent Fry, Ph.D.
Kansas State University, 1961

The photoelectric properties of uranium at temperatures ranging from 300°K to 1065°K and the changes exhibited in these properties at the two crystallographic

transformation temperatures, 938°K and 1043°K , have been studied.

The experimental tube consisted of a glass envelope enclosing a molybdenum collecting cylinder. The uranium specimen, which in every case was approximately 0.03 mm thick, 4 mm wide, and 7 cm long, was suspended in the form of a loop in the collecting cylinder. Iron tabs on the collecting cylinder made possible the rotation of the cylinder by means of an external magnet. Thus, the evaporation of uranium onto the quartz window of the glass envelope could be prevented during the long outgassing periods.

Photoelectric currents were produced by the radiation from a quartz-enclosed mercury arc dispersed by a Bausch and Lomb grating monochromator. A quartz lens was used to focus the radiation, through a thin quartz window and a hole in the collecting cylinder, onto the uranium specimen. Relative intensities of the spectral lines were obtained by use of a Reeder vacuum thermopile designed for use with the Bausch and Lomb monochromator. Photoelectric currents were measured with a Keithly micro-microammeter. Proper electrostatic shielding was provided for the experimental tube and the circuit carrying the emission current.

Specimen temperatures were determined graphically from a curve of temperature versus the heating current passing through the specimen. This curve was obtained by determining the heating currents at which the crystallographic transformations took place and then extrapolating between these temperatures and room temperature.

The vacuum system used in connection with the experimental tube consisted of a three-stage, silicone fluid, water-cooled diffusion pump, a copper-foil trap, an Alpert ionization gage, an Alpert-type ultra-high-vacuum valve, and a mechanical pump. With this system final pressures on the order of 10^{-10} mm of mercury were obtained.

The outgassing process consisted of the following steps: The Alpert valve, gage, copper-foil trap and experimental tube were baked several times at 450°C in an electric oven. The molybdenum cylinder was heated to red heat at intervals over a period of about two weeks. The heating current through the sample was slowly increased until the specimen was at about 1250°K . The total time in which current passed through the sample for purposes of outgassing was about 1,000 hours in every case. Heat treatment of this nature produced uranium samples which yielded stable, reproducible results.

The Fowler method of analyzing photoelectric data was used to determine the work function of three crystal-line structures. Fifty determinations were made of the work functions on two different samples during various stages of outgassing and over the entire temperature range. The work function for the orthorhombic structure was found to be $3.47 \pm .01$ eV; for the tetragonal $3.52 \pm .01$ eV; and for the body centered cubic $3.39 \pm .01$ eV.

The photoelectric current per unit light intensity at constant wave lengths was measured as a function of the temperature of the sample. These measurements were made over the entire temperature range with both increasing and decreasing temperature. Significant and sharp changes were found to occur in the photoelectric current per unit light intensity at the two temperatures at which uranium undergoes allotropic crystallographic transformations.

Microfilm \$2.75; Xerox \$3.00. 52 pages.

FERROMAGNETIC RESONANCE MAGNON DISTRIBUTION IN YTTRIUM IRON GARNET

(Order No. 61-3584)

Thomas James Matcovich, Ph.D.
Temple University, 1961

A new ferromagnetic resonance experiment is described which permits the investigation and evaluation of the magnon distribution at resonance. It is shown that the resonance frequency of a spherical sample is a function of the anisotropy field and that the anisotropy field is a function of the microwave power applied to the sample. The shift of resonance frequency with power is related to the number of $k = 0$ and $k \neq 0$ magnons. This relationship is derived from spin wave theory valid to fourth order in the spin wave operators and it is found that the $k \neq 0$ magnon contribution depends critically on the distribution of the magnons. Equipment and techniques were developed which permit the shift in resonance frequency, at X band frequencies, to be measured to ± 20 KC. Data was taken on five single crystal, spherical yttrium iron garnet samples in both the easy and hard magnetic directions. Observed shifts were typically of the order of 100 KC. It was assumed that the dominant mode of relaxation of the uniform spin waves is by means of two magnon interactions which do not conserve momentum. On the basis of the data it was concluded that the dominant contribution to the equilibrium magnon population is in the $60^\circ > \theta > 47^\circ$ range where θ is the direction of propagation of a spin wave with respect to the d.c. resonance field. The equilibrium ratio of $k = 0$ to $k \neq 0$ magnons was found to be of the order of unity.

Microfilm \$2.75; Xerox \$6.60. 136 pages.

SOME MULTIPLE ELECTRON PROBLEMS IN THE THEORY OF MAGNETISM

(Order No. 61-3276)

James Joseph Pearson, Ph.D.
University of Pittsburgh, 1961

Two problems are considered. In the first of these, a detailed calculation is made of the Moriya anisotropic superexchange interaction, $D \cdot S_1 S_2$, between magnetic ion spins in β MnS. Whereas Moriya's work utilized Anderson's new theory of superexchange and was confined to ions with one electron in the 3d shell, this calculation is performed with more customary superexchange methods and for a half-filled 3d shell. The unperturbed state is taken to consist of two Mn^{++} ions together with their common S^- nearest neighbor, each in a tetrahedral crystal field. The perturbing Hamiltonian contains the electronic spin-orbit interaction and the electron kinetic and coulomb energies. The mechanism involves going from the ground state to an excited crystal field state on one Mn^{++} ion by the spin-orbit effect, then back to the ground state by superexchange between the Mn's. The direction of the D vector is found to be perpendicular to the plane of the three ions, and its magnitude of the order of a superexchange integral times the spin-orbit parameter over a crystal field splitting energy. The existence of the

effect depends importantly upon π overlap between the Mn and S orbitals.

The second problem involves a theoretical calculation of the magnetic anisotropy in the cubic perovskite structure of $KMnF_3$ at room temperature and in its distorted structures at lower temperatures. These distortions are of two types: first, a small tetragonal distortion of the entire crystal; and then, below the antiferromagnetic Neel point, a distortion of the octahedron of fluorine atoms surrounding each manganese. The cubic anisotropy is obtained from a general spin-wave calculation of the zero-point dipole-dipole energy in a cubic antiferromagnet. The result is found to be the same as that for the ferromagnetic case. The anisotropy from the tetragonal distortion is obtained from the change in the classical Lorentz factors. In calculating the effect of the fluorine distortion a generalization is introduced of Kondo's method for obtaining the anisotropic effective spin Hamiltonian produced by overlap and electron transfer between an Mn^{++} ion and its non-magnetic neighbors. In its present form the method permits the ready calculation of this anisotropy for any symmetry and number of neighbors. Comparison with the microwave resonance and torque measurements of Portis, Teaney, and Heeger, reveals the last effect to be the most important and confirms the form of the spin Hamiltonian found here and its approximate magnitude.

Microfilm \$2.75; Xerox \$3.00. 59 pages.

ULTRASONIC PROPAGATION IN ALKALI HALIDES. (PARTS I AND II).

(Order No. Mic 61-1690)

Karl Reinitz, Ph.D.
Rensselaer Polytechnic Institute, 1961

Supervisor: H. B. Huntington

Part I.

The elastic constants of CaBr and CsI single crystals were determined ultrasonically as a function of temperature from 300 to 75 degrees K. Room temperature constants of RbBr and RbI samples were also measured. The values of C_{11} , C_{12} , and C_{44} in units of 10^{11} dynes/square cm at 22 degrees C for these salts are given in the table below:

	C_{11}	C_{12}	C_{44}
CsBr	3.097	.903	.7500
CsI	2.434	.636	.6316
RbBr	3.15	.493	.384
RbI	2.54	.407	.276

Our samples were oriented using Laue back reflection techniques. The crystals were then lapped parallel to 25 microinches. Transit times in RbBr and RbI were determined by the ultrasonic pulse echo technique. The accuracy and precision of the velocity measurements in these salts was 5 parts per 1000 and 3 parts per 1000

respectively. Transit times in CsBr and CsI were obtained with an ultrasonic interferometer. The accuracy of this instrument is 5 parts per 1000 while its precision was found to be 5 parts per 100000. The cesium salt velocities were measured while the sample temperature was allowed to increase at the rate of .3° C/min.

The temperature dependence of all cesium salt constants was negative and linear over the temperature range investigated. The values of the rubidium salt constants compare favorably with the values found by Bergmann and also by Spangenberg and Haussuhl.

Part II.

A cryostat was constructed enabling measurements of attenuation at low temperatures while the sample is being irradiated with a Co⁶⁰ gamma flux of 2.2 Kr/h.

It was found that the frequency dependence of the logarithmic decrement is linear at frequencies above 10 Mcs as predicted by the Granato-Lucke theory. From the attenuation vs dose curve, it was calculated that the density of pinning points along a dislocation line is 6.7×10^7 defects/min roentgen. This agrees favorably with the corresponding value found by Truell. The irradiation vs time curves at different temperatures showed that the lower the temperature of the irradiation, the smaller the fractional

attenuation change $\frac{\alpha_0 - \alpha_t}{\alpha_0}$, where α_0 and α_t are the pre-

irradiation and the saturation values of the attenuation respectively. Low temperature bleaching experiments revealed that if a sample is irradiated at -195°C and then illuminated at the same temperature, its attenuation will suddenly increase to almost its pre-irradiation value. Bleaching of a sample at -195°C while it is still being irradiated, will also cause the attenuation to rise, but the magnitude of this change is less than the change obtained when illuminating a sample after it has been taken out of the source, (though still kept at -195°C). The above effect can be easily reproduced, since turning the light on and off will cause the sample attenuation to increase and to decrease respectively. It is believed that the experiment is

analogous to the one performed by Gordon and Bauer on the kilocycle range monitoring the modulus of the specimen. Microfilm \$2.75; Xerox \$9.25. 203 pages.

TEMPERATURE DEPENDENCE OF MAGNETIZATION IN THIN NICKEL FILMS

(Order No. 61-3312)

King H. Rosette, Ph.D.

Case Institute of Technology, 1961

Thin nickel films, 248 Å and less in thickness, were prepared by vacuum deposition at pressures of 10^{-7} mm. Hg. Torque measurements indicate a more rapid decrease of magnetization with temperature for decreasing film thickness. This agreement with the Glass-Klein theory contradicts the bulk behavior observed for nickel films prepared and measured at ultra high vacuum by the same torque method. The presence of a surface layer, correlated with spin wave resonance experimental and theoretical results, suggests the importance of surface effects on spin wave excitation. It is possible that thermal excitation of spin waves is also dependent on surface conditions.

Microfilm \$2.75; Xerox \$3.00. 51 pages.

SOME ASPECTS OF THE INTERACTION OF ELECTROMAGNETIC RADIATION WITH MANY PARTICLE SYSTEMS

(Order No. Mic 61-2072)

Narkis Tzoar, Ph.D.

University of Pennsylvania, 1961

A second listing. For abstract please see page 893.

Microfilm \$2.75; Xerox \$5.60. 115 pages.

PHYSIOLOGY

HYSTERECTOMY AND OVARIAN FUNCTION IN SWINE AND CATTLE

(Order No. 61-3026)

Lloyd Lee Anderson, Ph.D.

Iowa State University of Science and Technology, 1961

Supervisor: Robert M. Melampy

This investigation deals with ovarian function in gilts and beef heifers following total and subtotal hysterectomy during the luteal phase of the cycle.

In 7 groups of 5 gilts per group the following parts of the uteri remained in the animals: Group 1, posterior half of cervix; Group 2, body and cervix; Group 3, anterior

one-fourth of right horn and posterior half of cervix; Group 4, anterior half of right horn and posterior half of cervix; Group 5, posterior half of right horn including body and cervix; Group 6, anterior halves of right and left horns and posterior half of cervix; and Group 7, sham operation. Nine of 10 gilts in Groups 1 and 2 did not show estrus during a 120 day period following the estrus prior to experimental treatment. Three of 5 gilts in Group 3 did not return to heat during a 70 day period following the estrus prior to surgery. All gilts in Groups 4, 5 and 6 had average estrous cycle intervals of 25 days as compared to 21 days for the same animals prior to hysterectomy. The sham-operated gilts in Group 7 had average estrous cycle intervals of 21 days.

In 4 groups, each consisting of 4 heifers, the following parts of the uteri remained in the animals: Group A, none (hysterectomy); Group B, cervix and body and in 2 cases the posterior portions of both horns; Group C, anterior quarter portions of the right and left horns; and Group D, anterior halves of the right and left horns. The 4 hysterectomized heifers in Group A did not show estrus during a 270 day period following the estrus prior to experimental treatment. Three estrous cycles were observed in each of 3 of the 4 heifers in Group B. One heifer in this group did not return to estrus during a 250 day period following the estrus prior to surgery. Three heats were observed in each of the 8 heifers in which only the anterior quarter portions of both horns (Group C) or the anterior halves of both horns (Group D) remained in the animals.

The results from these experiments dealing with swine and cattle indicate that in the absence of the uterus the corpus luteum persists for a period of time equivalent to that of gestation. These findings would suggest that the non-pregnant uterus produces a stimulus which may function (1) as a hormone acting directly on the corpus luteum or indirectly by way of the pituitary (feed back mechanism) (2) as a local neurohumoral substance which may influence afferent nerves from the uterus and thereby modify pituitary function by way of the hypothalamus. In the absence of the uterus this stimulus would not be present. When only a portion of the uterus remains in the animal, this stimulus for the regression of the corpus luteum is present. In the case of the pregnant uterus, this influence would be absent. However, the mechanism which causes the maintenance of the corpus luteum following removal of the uterus may be unrelated to that which brings about the persistence of the corpus luteum in the pregnant animal.

Microfilm \$2.75; Xerox \$4.20. 78 pages.

MINERAL METABOLISM AND MICROCIRCULATION IN THE HIBERNATING HAMSTER

(Order No. Mic 61-2417)

Francis Louis Maynard, Ph.D.
Boston University Graduate School, 1961

Major Professor: George P. Fulton

Mineral metabolism and certain circulatory phenomena, all of which are thought to be influenced by the steroid hormones of the adrenal cortex, were studied in hibernating, cold stressed, and normal hamsters.

Hibernation was induced by prolonged exposure to a temperature of 6°C. Chronic cold stress resulted from exposure of hamsters to the same conditions which induced hibernation, but for a shorter time. Acute cold stress was brought about by surrounding the body of the test animals with a copper coil through which ice water was pumped. Body temperature was measured by means of a thermistor type thermometer with the sensing probe inserted deep into the cheek pouch.

Blood was withdrawn by cardiac puncture and the serum was analysed for its content of sodium, potassium, magnesium, and chloride. Determinations of sodium and potassium were made by flame photometry (White, J. U.,

Analyt. Chem. 24: 394-399, 1952). Determination of magnesium was made by a microcolorimetric method (Orange, M., and H. C. Rhein, J. Biol. Chem. 189: 379-386, 1951). The chloride content of the serum was obtained by titration of the blood serum with mercuric nitrate delivered from a microburette (Schales, O., and S. S. Schales, J. Biol. Chem. 149: 879-884, 1941).

The circulatory phenomena studied include direct microscopic observation of the microcirculation of the cheek pouch at magnifications from 10x to 100x, the susceptibility of the blood vessels of the cheek pouch to formation of petechial hemorrhages, hemoconcentration and blood clotting time. The tissue mast cells of the cheek pouch were also studied to determine if changes in the number and morphology of these unicellular endocrines could be correlated with the fact that thromboses do not form in the blood vessels of hibernating animals in spite of their sluggish circulations.

Susceptibility to formation of petechiae was evaluated by an original positive pressure method and by the use of the moccasin venom test (Arendt, K. A., and G. P. Fulton, A. J. Physiol. 183: 594, 1955). Hemoconcentration and blood clotting time were determined upon digital tip blood by capillary tube methods. The tissue mast cells were studied by a sampling procedure (Fulton, G. P. and F. L. Maynard, Proc. Soc. Exp. Biol. Med. 84: 259-260, 1953).

The results of this investigation show a significant rise in the levels of sodium, magnesium, and chloride ions in the blood serum of hibernating hamsters, whereas the value for potassium remains essentially normal.

The microcirculation of the cheek pouch of hibernating hamsters is characterized by dilated blood vessels, stasis, erythrocyte packing, slow and reversed flow and "slow" vasomotion. Cold stress *per se* does not account for these changes. Moreover, the blood vessels of the cheek pouch in hibernating hamsters, are much more susceptible to the formation of petechial hemorrhages than those of cold stressed or normal animals. Hemoconcentration and significantly lengthened blood clotting time were constant findings in the hibernating animals.

The numbers and morphology of the tissue mast cells were not influenced by the transition to the dormant state in these animals and the absence of thrombi from the circulation of hibernating hamsters is apparently not due to a circulating anticoagulant released by mast cells of the cheek pouch.

The fact that the chemical and physical parameters of the circulation described above are influenced by hormones of the adrenal cortex suggests that altered ratios of adrenal steroid production may influence the induction and maintenance of dormancy in this species.

Microfilm \$2.75; Xerox \$4.60. 89 pages.

COCONUT WATER AS AN EXTENDER
FOR BOVINE SEMEN
AT ROOM TEMPERATURE

(Order No. 61-3017)

Fernando Luis Oliver, Ph.D.
Kansas State University, 1961

Nine experiments were conducted to determine if a coconut water extender could be suited to commercial artificial breeding operations.

Semen was obtained from randomly selected bulls which are in use at the Kansas Artificial Breeding Service Unit. Semen collection and processing procedures typical of commercial stud operation were used to obtain, evaluate, and process the semen. Sperm motility in extended semen samples during a seven day storage period was the criterion used to determine the value of coconut water as a bovine semen extender.

The results obtained in Experiment I indicated that semen extended in coconut water extender (CWE), using normal sanitary precautions observed in commercial artificial breeding organizations, deteriorated rapidly. Motility of sperm after the third day of storage fell to below 40 per cent.

The results obtained in Experiment II indicated that motility of sperm in CWE was impaired by a decline in pH of the solution due to contamination of the samples. Semen samples extended in the modified coconut water extender (MCWE) prepared under more rigid sanitary conditions showed no signs of contamination, only slight changes in pH, and sperm motility remained above 40 per cent during seven days of storage. Highly significant correlations were observed between the pH of the samples and sperm motility.

The results obtained from Experiment III indicated that sulfanilamide added to coconut water extenders at the rate of 300 mg. per cent enhanced sperm motility and therefore should not be omitted from the extender.

Experiments IV, V, VI, VII, VIII and IX were conducted with the modified coconut water extender which was prepared under rigid sanitary conditions.

The results of Experiment IV indicated that room temperatures varying from 74° to 88° F. appear to be optimal for storage of coconut water extended semen.

The results of Experiment V showed that sperm extended in a coconut water extender cannot be stored for more than one day at 40° F., and for more than two days at 50° F. However, sperm tolerated storage at a constant temperature of 100° F. for four days. It appears that 40° and 100° F. are the minimum and maximum temperatures tolerated by sperm suspended in the coconut water extender.

In Experiment VI it was demonstrated that the addition of glycerol at levels varying from 5 to 15 per cent by volume to the modified coconut water extender is detrimental to sperm motility.

The results of Experiment VII indicated that the addition of egg yolk to a coconut water extender at 0.5 or 5 per cent levels protected sperm from cold shock, thus making storage possible at 40° F. during a seven day period. These results suggest that coconut water extender may be used in temperate climates during the cold months.

In Experiment VIII it was found that a thermos bottle or similar equipment can be used for storing and trans-

porting semen for periods of eight hours when the ambient temperature is below the optimum level for storage of semen extended in the modified coconut water extender (MCWE).

The results of Experiment IX showed that sudden exposure of coconut water extended semen stored at room temperature to temperatures in the range of 30° to 40° F. does not result in cold shock of sperm.

This extender appears to offer great opportunities in regions where a constant supply of coconuts would be available at reasonable prices. It maintains a high percentage of actively motile sperm for three to four days longer than the glycerinated egg yolk and milk extenders, and is adapted to a wider range of variations in temperature. Coconut water extender eliminates the need for refrigerated storage under laboratory and field conditions thus reducing shipping charges and making it easier for technicians to transport it in the field.

Microfilm \$2.75; Xerox \$3.00. 56 pages.

AN ACTION SPECTRUM OF
ULTRAVIOLET EFFECTS ON DIVIDING
BLEPHARISMA UNDULANS

(Order No. Mic 61-2606)

Leah L. Schorr, Ph.D.
New York University, 1958

Adviser: Professor Henry I. Hirshfield

Groups of *Blepharisma undulans* were irradiated during interphase, early fission and late fission with 5000 ergs/mm² of monochromatic 265 mμ ultraviolet (Series A). Animals in late fission, the most sensitive stage, were irradiated with 5000 ergs/mm² of monochromatic 230, 254, 265, 280, 291 and 334 mμ ultraviolet in an action spectrum study (Series B). A total of 34-56 animals was irradiated at each stage or at each wavelength. Clonal daughters were used in each experiment. Immediately after irradiation *Blepharisma* were isolated in lettuce-*Pseudomonas* medium in Kline depression slides. Irradiated isolates and controls were stored in dark moist chambers at approximately 24°C. Observations were made immediately after irradiation, daily for one week and on alternate days for the second and third weeks, using dissecting and darkfield microscopes. Methyl green preparations, made at selected intervals, were observed for nuclear effects.

Differences in sensitivity among the various stages irradiated at 265 mμ were observed. Greatest delays of first fission occurred in interphase animals. Dividing animals tended to complete the fission in progress. First fission delays for animals in division at the time of irradiation reflect immediate effects on furrowing in contrast with delayed effects on first fission events in interphase animals. The furrow was more stable to ultraviolet in late fission than in early fission. First fission delay for interphase animals is, in a sense, comparable to second fission delay for irradiated dividing animals.

Delays of second and third fissions, as well as macro-nuclear vacuolization, were greatest in late fission, intermediate in early fission and least in interphase animals.

The great sensitivity of late fission animals to 265 m μ ultraviolet may be attributed to the greater dose delivered to the elongating macronucleus, and especially to critical changes in chemistry or orientation of nucleic acid and protein components which may occur during establishment of the complex noded macronucleus in late fission.

A degree of independence of cytoplasmic and nuclear events of fission was demonstrated in the dividing animal. Furrowing was more susceptible to ultraviolet inhibition at all tested wavelengths than immediate macronuclear events. When the furrow was inhibited the subsequent fate of the daughter macronuclei appeared associated with cytoplasmic changes. Reorganization of the two peristomal regions to form a single functioning peritome prior to completion of fission was accompanied by fusion and reorganization of daughter macronuclei.

The action spectrum for first fission delay in late fission animals (series B), with its peak at 280 m μ and a sharp rise toward 230 m μ from the 254 m μ minimum, resembles the absorption spectrum for simple protein. Furrowing was most inhibited by the superficially absorbed 230 m μ ultraviolet, suggesting a direct effect on furrow proteins. Greatest macronuclear vacuolization occurred at 280 m μ , suggesting effects on protein.

The action spectrum for delays of second and subsequent fissions in late fission animals resembles the absorption spectrum for nucleic acid, with a shift toward the protein absorbing wavelengths. This is interpreted as indicating possible effects on nucleic acids and, to a lesser extent, on proteins and/or nucleoproteins of the reorganizing macronucleus in late fission.

Late fission animals irradiated at 265 m μ , 254 m μ and, perhaps 280 m μ , were delayed most at second fission, reflecting perhaps the great sensitivity of the reorganizing macronucleus characteristic of late fission. The effect of 230 m μ and 334 m μ irradiation on fission appeared entirely at first fission, with recovery of normal fission rate by second fission. Maximal recovery occurred at all wavelengths by fourth or fifth fission.

No evidence for an increased delay at third or fourth fission in irradiated late fission animals was found, as has been described in other studies for interphase animals. Interphase animals irradiated at 265 m μ (Series A) may show an increased delay at third fission.

Immediate visible effects, as inhibition of motility and loss of anterior cytoplasm, were most profound in the 230 m μ and 280 m μ groups, suggesting effects on gel structural protein. Delayed effects, as inhibition of repair and growth processes, were most marked in the 265 m μ , 254 m μ and 280 m μ groups, indicating effects on nucleic acid and protein components. The occurrence of large animals with apparently "polyploid" macronuclei among animals delayed at second or third fission by 265 m μ and 254 m μ irradiation indicates separable ultraviolet effects on synthetic mechanisms and fission.

No direct photooxidative bleaching of the characteristic pink subpellicular pigment occurred at the wavelengths and dose used. Apparently specific absorption by the pigment at 334 m μ and nonspecific cortical absorption at 230 m μ resulted in aggregation of apparently altered pigment granules as yellow-brown hyaline masses. These were gradually metabolized and disappeared.

Late fission animals were most susceptible to lethal

effects of irradiation at 265 m μ (Series A). Early fission animals showed an intermediate susceptibility and interphase animals were least affected. Deaths were delayed, occurring during the second and third weeks. Affected animals became progressively smaller prior to lysis, indicating a progressive collapse of synthetic mechanisms. In the action spectrum study of late fission animals (Series B), deaths occurred only in the 230 m μ group within 24 hours, indicating the great sensitivity of the cytoplasm to this superficially absorbed wavelength.

A role of physiological condition in ultraviolet sensitivity is demonstrated by the greater fission delays produced in the less vigorous Series A late fission animals irradiated at 265 m μ by comparison with the corresponding Series B animals receiving the same dose; and by the occurrence of considerable deaths in this same Series A group by contrast with the lack of deaths in the corresponding Series B group.

Microfilm \$2.75; Xerox \$7.40. 160 pages.

VARIOUS FACTORS AFFECTING ARTIFICIAL INSEMINATION IN SWINE

(Order No. 61-3171)

Frederick William Stratman, Ph.D.
The University of Wisconsin, 1961

Supervisors: Assistant Professor H. L. Self,
Professor V. R. Smith
Associate Professor E. R. Hauser

Part I

Various diluents or extenders were tested for their ability to maintain spermatozoa motility at 9°C. Heated homogenized whole milk maintained spermatozoa motility for the longest storage time. The same diluent was more satisfactory than the others when the seminal fluids were removed. Removal of seminal fluids also improved storage.

Split ejaculates were used to artificially inseminate twenty pairs of gilts with fresh diluted semen or diluted semen stored for 12 hours at 9°C. Heated homogenized whole milk containing 1000 mcg. per ml. was used as a diluent. The 3-day fertility and conception rates of fresh and stored diluted semen were not significantly different.

Part II

Four 3-day fertility trials were conducted with 97 sows of various breeds and ages.

Artificial insemination was equal to natural service in fertility and conception rate at 3-days gestation in sows.

The second day of estrus appeared to be a more optimum time to artificially inseminate sows than the first day.

If early weaning (4 weeks post-partum) was practiced, the 3-day fertility and conception rate was significantly higher in sows artificially inseminated on the second day

of the second post-lactation estrus than at the first post-lactation estrus, but there was no difference in 3-day fertility and conception in the sows inseminated on the first day of estrus at either of the post-lactation periods.

Part III

One hundred-twenty gilts were artificially inseminated with either 50 or 100 ml. of fresh strained whole semen. There was no difference in conception or embryo survival to the twenty-fifth day of gestation.

Seventy-three gilts artificially inseminated with 2.5×10^9 spermatozoa suspended in 20 ml. of diluent were assigned to a control group, a group receiving 10 I.U. of oxytocin intra-uterine, or a group receiving 10 I.U. of oxytocin intravenously. The intravenous administration of oxytocin caused an insignificant improvement in 3-day fertility and litter size.

Seventy-two gilts were artificially inseminated with either 10, 20 or 50 ml. of semen containing either 2.5, 5.0 or 10×10^9 spermatozoa. At 3 days gestation there were no significant differences in fertility or litter size. However, at 25-days gestation, the group inseminated with 50 ml. volume had a significantly higher embryo survival and conception rate than the 10 or 20 ml. volume regardless of the number of spermatozoa used.

One hundred-twenty-gilts were artificially inseminated with either 2.5 or 6.25×10^9 spermatozoa suspended in either 20 or 50 ml. of diluent. Various quantities of oxytocin and epinephrine were injected intravenously, intra-uterine or intramuscularly. The method of administration of oxytocin had no effect on 3-day fertility, conception or litter size. Epinephrine administered intramuscularly appeared to decrease embryo survival a nonsignificant amount to the twenty-fifth day of gestation. The addition of estrogen to the diluted semen just prior to insemination had no significant effect on embryo survival to the twenty-fifth day of gestation.

Ninety-six sows were bred on the second day of estrus by natural service or artificially inseminated with 2.5×10^9 spermatozoa in 50 ml. of diluent, 2.5×10^9 spermatozoa in 100 ml. of diluent or 1.25×10^9 spermatozoa in 100 ml. of diluent. There were no significant differences in conception rate, embryo survival or litter size at 25-days gestation.

Part IV

One-half of 24 sows on a farm were mated naturally and the remainder artificially inseminated on the second day of estrus with semen from the same boars. The mean number of pigs per sow bred and per sow farrowed did not differ significantly nor did the percent pregnant of those conceiving at first service.

Microfilm \$2.75; Xerox \$6.20. 126 pages.

ELECTROPHYSIOLOGY OF THE HYPOTHERMIC HEART

(Order No. Mic 61-1100)

Joseph Charles Torres, Ph.D.
Boston University Graduate School, 1961

Major Professor: Albert H. Hegnauer

I. Introduction

In the past decade, hypothermia has been extensively investigated as a means of reducing oxygen requirements of the body sufficiently to allow exclusion of the heart from the circulation and so permit intracardiac surgery under direct vision. Because of its ability to reduce metabolism, it has suggested itself as a potentially valuable technique not only in a variety of clinical conditions but as an investigative tool for the elucidation of normal bodily functions. One of the inevitable consequences of inducing hypothermia in mammals is the increased irritability or electrical instability displayed by the myocardium, culminating in the terminal event, ventricular fibrillation.

The purpose of the present experimental study: to attempt a quantitative evaluation of the nature and magnitude of change provoked by hypothermia in the fundamental cardiac parameters of rhythmicity, conduction, refractoriness and excitability as well as the processes of depolarization and repolarization, with a view to determining, if possible, the electrophysiological basis for the increased susceptibility to cardiac arrhythmias.

II. Methods

All dogs were anesthetized with pentobarbital and surface cooled by immersion in an iced water bath. Various minor surgical procedures were instituted to prepare the animals for experimentation. They included: tracheal intubation, cannulation of the jugular vein and the carotid artery (for blood pressure), insertion of a catheter electrode into the right atrium and the suturing of both bipolar and monopolar electrodes to the ventricular surface.

A variety of instruments were employed to deliver electrical pulses to the heart by way of the attached electrodes; included in these were Grass, Tektronix, and AEL square wave stimulators as well as the sawtooth output of a Tektronix 551 dual beam oscilloscope.

All cardiac potentials, both direct and from external leads, were projected on a dual beam oscilloscope and photographed with a special Polaroid camera. Differentiation of the QRS complex was accomplished with the aid of a Philbrick 'D' unit, and then recorded along with the ECG on a Sanborn Twin-Viso.

III. Results

Hypothermia was found to produce a basically linear depression of the spontaneous heart rate with no evidence that the discharge from the normal pacemaker became sporadic with cooling. Neither atrial nor ventricular artificial

pacemakers served to alter the incidence of ventricular fibrillation in hypothermia. Ventricular excitability during the diastolic phase was evaluated by means of responses to square wave stimuli of varying durations. The mathematically derived time constant of excitability (k) was shown to be decreased under hypothermia. Much qualitative evidence was obtained indicating that the decrease in excitability in hypothermia is accompanied by a similar decrease in accommodation. Conduction velocity at four different sites on the myocardium was measured during progressive hypothermia. It was found that although a considerable number of discrepancies exist normally among different ventricular regions, these were not accentuated by cold. Hypothermia prolonged conduction time to an equal extent in both differentiated and non-differentiated pathways. The first derivative of the QRS representing ventricular depolarization was slowed uniformly at low temperatures, indicating that conduction was not impaired differentially in any one portion of the heart. The refractory periods measured with both cathodal and anodal stimuli showed an approximately similar extent of prolongation, with the relative refractory period occupying a consistent portion of the total phase of refractoriness at all temperatures. The period of anodal dip, however, (that

interval in the RRP in which the anodal threshold becomes less than the cathodal) showed a consistent increase in duration as the temperature was lowered. Electrocardio and vectorcardiographic analysis demonstrated that ventricular depolarization is relatively unaffected by cold. In contrast, the process of repolarization exhibited an extreme thermolability with gross but inconsistent changes appearing in the S-T segment and repolarization vector. These non-systematic alterations in the S-T waves were mimicked by corresponding inconsistencies in the orientation and magnitude of the ventricular gradient.

IV. Summary

In general, the processes of excitability, depolarization and conduction are not seriously affected by hypothermia, at least not to the extent where they could be implicated with justification as causative factors in the increased myocardial irritability. In contrast, the processes of recovery of excitability and repolarization appeared to be greatly prolonged by cold with the possibility of distinct phase differences existing in different areas.

Microfilm \$2.75; Xerox \$8.00. 175 pages.

POLITICAL SCIENCE

POLITICAL SCIENCE, GENERAL

COLONIAL POLICY AS A MAJOR VARIABLE FORCE SHAPING POLITICAL CHANGE IN AFRICA: A CASE STUDY OF UGANDA, 1905-1945.

(Order No. Mic 61-2413)

Charles Henry Walter Howe, Ph.D.
Boston University Graduate School, 1961

Major Professor: Jeffrey E. Butler

The dissertation is a case study of the effect of colonial policy on political change in a dependent African territory--the Uganda Protectorate--from 1905 up to 1945.

It is developed within an analytical framework purposely designed for broader, comparative use. Five human, societal forces are singled out as major variables affecting political change in a large part of Africa during most of the colonial era. They are: the traditional African political systems; the policies of the colonial powers; alien contact and influence; events and issues; and the social situation and social change. All of the variables, as they interacted in the Protectorate, are considered at one or more stages in the dissertation. But, carried out as a library research project in the United States, this work places the main emphasis on the second of the forces--colonial policy.

The study is directed specifically to the problem of the assessment of British policy's role in the extent of political change in Uganda. The focus is on change in political institutions for governing the African population at both the local level and the territorial level. As for the former, a distinction is made in turn between the tribal areas of direct and indirect rule.

From the inquiry's findings, conclusions are drawn which substantiate a thesis about the importance of policy--in relation to the other variables--in shaping the differing extent of change which occurred in the three categories of political institutions distinguished above.

The examination of native administration policy reveals that although for much of the period Protectorate officials viewed their policy for the entire territory as the application of the classic British concept of Indirect Rule, of the twelve main tribes surveyed none but the people of the Kingdom of Buganda were in fact ruled indirectly. Approached analytically, British rule of the eleven smaller, non-Baganda tribes was in reality direct; and for the majority of them it was decidedly direct. It is shown that in the latter cases--the Acholi tribe receives particular study--the change in the traditional political institutions was extensive; and that the direct rule policy was the primary causal factor. As for the Baganda, change in their traditional political system was relatively limited; and the two most important forces shaping the extent of

the change were the adaptive Buganda system itself and the indirect rule policy.

Change in the territory's central political institutions--Governor, Administrative Organization, Executive Council, Legislative Council--is found to have been limited; and it is concluded that this was primarily attributable to British policy in its several aspects. With special reference to the Legislative Council, the policies toward the central institutions were themselves inhibitive to change. Other policies which operated with similar effects, though in most cases probably not by design, included the tribally variant native administration policies; the regionally disparate economic and social policies, relating to agricultural production, labor, and education; and the official predispositions toward federation of East Africa. The consequences of these diverse policies were, for example, such as to limit pressures for central institutional change from Africans in the areas of pronounced direct rule; and to facilitate as well as engender specific Baganda opposition to mooted African representation in the Legislative Council.

In addition to the conclusions presented regarding the thesis, several hypotheses are formulated concerning the generalized relationships of some of the forces as they varied and interacted in different combinations in Uganda, assessments are made of the validity of theoretical postulates advanced by certain other writers, and a critique of British policy in the Protectorate is provided at the end.

Microfilm \$9.55; Xerox \$34.00. 754 pages.

"THE CONSENT OF THE GOVERNED": AN ANALYSIS OF SOME REPRESENTATIVE THEORIES.

(Order No. 61-2932)

Fred Hale Willhoite, Jr., Ph.D.
Duke University, 1961

Supervisor: John H. Hallowell

"The consent of the governed" is an historic phrase customarily linked with political democracy. However, analysis of the ideas of some of the most noted political thinkers in the Western tradition demonstrates that the role of consent in communal life has posed a fundamental problem for all political speculation in that tradition, and not merely for explicitly democratic theory.

To gain perspective on this problem, a rough but meaningful distinction can be made between a "rationalist" and a "voluntarist" current in Western political thought. In classical-Christian rationalism, reason is considered to be man's highest faculty, capable of instructing him in the objective moral good and of controlling his passions so

that he may attain rational ends. Voluntarism conceives of man as fundamentally passionate and capable of using his rational faculty solely as an instrument for the fulfillment of his nonrational desires. The nature and role of consent in a particular theorist's doctrine depends in large measure upon which of these conceptions of human nature he essentially adheres to.

On the basis of the evidence presented in successive chapters analyzing the ideas of Cicero and the Roman Lawyers, Saint Thomas Aquinas, Marsilius of Padua, three Protestant theorists (Calvin, the author of the *Vindiciae contra Tyrannos*, and George Buchanan), Hobbes, Locke, and Rousseau, the author concludes that there are three principal meanings or functions of consent in Western political thought.

First, consent may be conceived of as essential to the creation and maintenance of civil society itself. This is the position of thoroughgoing voluntarists (Marsilius, Hobbes, and Rousseau), for whom man is a passion-guided egoist. In Hobbes' view, the consent of fear-driven men to the establishment and continued existence of an absolutely powerful sovereign constitutes the logical basis of peaceful and ordered society. Rousseau teaches that man's passion for autonomy permits the creation of legitimate political authority solely on a foundation of free individual consents. Rationalists (Cicero, Aquinas, Calvin, the writer of the *Vindiciae*, Buchanan, and Locke) conceive of man as a social and political animal. Life in civil society is a natural necessity for the human species, and structures of ordered authority based on variations in wisdom and ability are likewise natural to man. (Locke, an ambiguous rationalist, insists on the necessity of consent to create political authority and obligation, although he agrees that men are naturally sociable.)

Second, consent may be conceived of as the measure of law and/or political institutions. Rationalism, however, is primarily concerned for the realization in human law of the moral ends laid down by the rational and eternal law of nature, whereas voluntarism tends to emphasize the importance of consensual means (whether genuine and active, as in the doctrines of Marsilius and Rousseau, or as a façade for absolutism as espoused by the Roman Lawyers and Hobbes) as the only ethically valid and/or practical basis for institutions of lawmaking and rulership.

Third, and most fundamentally, consent may designate consensus, a basic agreement upon essential principles and practices which binds together a people's political life. Cicero summarizes the essential rationalist tradition in contending that an understood "agreement on law and rights" underlies civil society; the people expect the government to seek to realize the rule of reasonable justice in practical affairs. In voluntarist theories the consensual focal point is a common individual passion--for the "sufficient life" (Marsilius), to escape the threat of violent death (Hobbes), or to be free of external direction (Rousseau)--which is at bottom the human desire for self-preservation.

Microfilm \$5.05; Xerox \$17.80. 395 pages.

POLITICAL SCIENCE, INTERNATIONAL LAW AND RELATIONS

A STUDY OF THE ROLE OF THE INTERNATIONAL STAFF/SECRETARIAT OF THE NORTH ATLANTIC TREATY ORGANIZATION DURING THE TENURE OF LORD ISMAY AS SECRETARY GENERAL

(Order No. Mic 61-1990)

Robert Smith Jordan, Ph.D.
Princeton University, 1960

The North Atlantic Treaty Organization, in the public image, has represented military preparedness (or unpreparedness), Atlantic Community, political harmony (or disharmony), and to some extent economic and financial cooperation. Most of these aspects have been discussed at length both by the spoken and written word. A most important, and hitherto unwritten aspect of the Alliance has been the actual detailed workings and roles of the leading civilian agencies: the Council, the Office of the Secretary-General, and the Staff/Secretariat.

These agencies have been described in general terms (in journals, books, public speeches; as parts of comparative functional studies of international organizations), in historical terms, or in a combination of the two. They have not been treated as a self-contained area of activity within the Alliance framework, performing duties and fulfilling roles in some ways related to one another, and in other ways disparate.

The purpose of this thesis, using unpublished documents and interviews as well as published materials, is to trace the development of the role of the Staff/Secretariat during the tenure of Lord Ismay as Secretary-General. As the name "Staff/Secretariat" implies, this central civilian body discharged a dual service. One service was to perform the duties of a Secretariat to the Council, Council Committees, sub-Committees and Working Groups. The Secretariat system, based on the British Cabinet model, was introduced into international administration by the first Secretary-General of the League of Nations.

The other service was to respond to the operating needs of the Alliance as they hinged upon economic, financial or logistical matters. Hence the creation of a central Secretariat under an Executive Secretary who was Secretary to the Council, and at the same time the creation of four functional Divisions and two Independent Offices reporting directly to the Secretary-General.

The approach used in the thesis has been partly chronological and partly functional. The functional approach has been applied in questions of management and organization, whereas the chronological approach has been used in tracing origins and evolutions. It has not been the purpose of the writer to be merely descriptive or recitative. Where appropriate, the situations under consideration are analyzed and related to the political context in which they existed.

A significant part of the thesis is devoted to the problems encountered in the internal administration of the Staff/Secretariat, including the employment characteristics peculiar to the so-called international civil servant. These matters are developed in detail not only because they bring to light important conditions bearing upon the role of the Staff/Secretariat in the life of the Alliance, but also because

they show the obstacles as well as the opportunities for building an international civil service. The over-riding fact is that the mission of an international organization and the uses to which the international organization is put by the member nations, control in large measure the international civil servant's work situation and his personal existence. This fact is amply demonstrated in the experience of the Staff/Secretariat.

Such questions as emoluments, recruitment and promotion procedures, although capable of being administratively organized into a uniform system which in theory could be applied to international organizations in general, are confronted in N.A.T.O. by questions of expediency, diversity of fiscal responsibility, and national policies. The subordination of the former to the latter still remains one of the pervasive facts of international life and should not be overlooked in contemplating the future of international administration.

The inviolability of the principles of public personnel administration based on the merit system has never been upheld without significant qualifications when they have been applied to international organizations. To assume that they can be valid today is to believe something more apparent than real, as the experience of the Staff/Secretariat bears out.

In regard to the political sphere – as opposed to the administrative – the work of the Council both in method and achievement shows that what the member nations did during the years of Lord Ismay's leadership was correlated to what they felt was in their individual best interest, rather than to any abstract interest of the Alliance. The extent to which Lord Ismay and his Staff/Secretariat were able to create an "alliance interest" which supplanted any confluence of national interests depended upon the sufferance of the member nations.

The notion that a member nation's interest, if it is its true interest, should *ipso facto* also be the interest of the Alliance falls under the weight of its own contradiction. Fifteen national interests simply do not add up to one Alliance interest in every sphere of the Alliance's activity. By the same token, an international civil servant who acts in what could be considered the organization's true interest will not, in every case, act in the interest of his own nation as that interest is interpreted by his Government.

Any specific convergence of national interest in N.A.T.O. was achieved through the traditional methods of negotiation, mediation, compromise and bargaining. The unique position of the Secretary-General as both the servant of the Council (in his role as Head of the Staff/Secretariat), and at the same time as a sitting member and presiding Officer of the Council (in his role as Vice-Chairman, later Chairman), gave him opportunities to exert his influence in this essential activity which were not as readily available to his League of Nations and United Nations forebears. The thesis therefore deals at length with the inter-relationship of the Council, the Secretary-General and the Staff/Secretariat in this respect.

In summary, the thesis develops the point that N.A.T.O. stands as much in the growing tradition of "functional international organization" as in the tradition of historic military alliances. The various Divisions and Independent Offices of the Staff/Secretariat, although applying themselves to matters of military financing, equipping and supply, are establishing precedents and relationships, and working

out problems which can have a significant impact on the development of international administration.

Last but not least, the achievements of the Staff/Secretariat and Lord Ismay during the years 1952-1957 have contributed in large measure to the political success of the Alliance and to its prospects of a long and fruitful life.

Microfilm \$6.70; Xerox \$23.65. 525 pages.

THE IDEA OF NATIONALISM IN SOVIET FOREIGN POLICY

(Order No. Mic 61-2412)

Seymour Slessinger, Ph.D.
Boston University Graduate School, 1961

Major Professor: Andrew Gyorgy

This dissertation is the product of an investigation into the meaning of Soviet Russian use of nationalism as an instrument of foreign policy during the period of Lenin and Stalin. It is intended to show: (1) that the employment of nationalism was consistent with ideas advanced by Marx and Engels; (2) that the Soviet successes in foreign relations depended to a large extent on the encouragement of nationalism at home and abroad; and (3) that the chief weakness of this method was that it contributed to the growth of deviationist tendencies among non-Russian Communists.

For the purpose of this study, principal reliance was placed on original documentation. This included the works of leading Marxists of the nineteenth and twentieth centuries on the national question, the writings of the Soviet leaders on the use of nationalism in foreign policy, and those of other Communist spokesmen on Soviet foreign policy. To complement these sources, use was made of reports published by non-Communist statesmen and diplomats who had personal contact with the Soviet leaders, and those of political refugees who formerly lived under Communist rule. Also employed were books and articles by Western scholars and reports by leading newspapers.

The method of the dissertation is historical and analytical. Initially, the idea of using nationalism as an instrument of Communist policy is traced from its origin in the writings of Marx and Engels to its revival and enlargement by Lenin. Thereafter, attention is focused on Soviet exploitation of nationalism in foreign policy from 1918 to 1953. Five chapters are employed, each defining a major period of Soviet policy. In each, consideration is given the particular reason for the use of nationalism, the method of its employment, and its contribution to the Russian purpose.

One conclusion drawn from this study is that the Soviet use of nationalism was consistently Marxist. It was derived from a revolutionary plan conceived by Marx and Engels to promote socialist uprisings in Europe by encouraging Irish and Polish nationalists to fight for their freedom. Irish independence was intended to undermine capitalism in England and, in turn, on the European continent as well. Polish independence was meant to protect the socialist revolutions against intervention by Tsarist Russia.

A second conclusion is that Lenin's adaptation of Marx's expedient nationalism contributed significantly to the success of Soviet foreign policy. For example, the stimulation of nationalism in Russia proper and in the border regions of the former Russian Empire helped to defend Soviet power against the Central Powers, the "white" Russian counterrevolutionary armies, and the Polish army, in 1918-1920. Furthermore, the use of nationalistic symbols facilitated the Communist conquest of most of the separated border regions, while the encouragement of Asian nationalism contributed to the decline of Western influence in the East. Finally, Lenin's tactics provided the model for Stalin's defensive strategy during the Second World War and for his postwar conquests in Eastern Europe.

A final conclusion is that the expedient Soviet promotion of nationalism also contributed to the growth of "left" and "right" deviationist tendencies among non-Russian Communists. On the one hand, the "left" deviationist refused to accept the subordination of his own revolutionary aspirations for the sake of promoting local national interests. On the other hand, the "right" deviationist, who accepted the encouragement of nationalism as a permanent feature of Communist policy, refused to subordinate himself to Moscow's will after achieving power in his own country. As illustrated by the "left" deviationism of Asian Communists in 1926 and the "right" deviationism of Tito in 1948, to name only two, the problem was a serious one.

Microfilm \$6.05; Xerox \$21.40. 473 pages.

RELATIONS BETWEEN THE NETHERLANDS GOVERNMENT-IN-EXILE AND OCCUPIED HOLLAND DURING WORLD WAR II

(Order No. Mic 61-1098)

John Herbert Woodruff, Ph.D.
Boston University Graduate School, 1961

Major Professor: Hubert S. Gibbs

The present study deals with the relations of the Netherlands "London" Government with the German-occupied territory during World War II.

The writer begins with the postulate that the London Government might be expected to provide in some measure for the maintenance of domestic order, for the welfare and safety of its citizens in the occupied territory; that it would be able to maintain communications with that territory; to serve as a focus for national unity; and to maintain its existence in order to assume authority at the time of liberation.

Owing to the nature of the German occupation, the London Government could neither directly engage in "remote" administration nor provide directly for the welfare and safety of its citizens. A single major exception appears in an effective railway strike ordered by the London Government.

London was able to assist organizations which did act in the general welfare. These include the National Support Fund, which expended \$68,000,000, repayment of which was guaranteed by London; the Fugitive Aid Organization, which concealed and fed as many as 500,000 persons at one

time; and groups preparing forged identity papers. Examples of London's maintenance of communications with the occupied territory include clandestine "routes" for intelligence gathering purposes, operated through neutral countries; Radio Orange, the Netherlands government broadcasting station in London; and the dispatch by the London Government of agents to Holland to gather information there.

The London Government did serve as a focus of national unity, as well as remaining intact to be able to function at the conclusion of hostilities. Radio Orange served as an important instrumentality in bringing the Government and occupied Holland into closer contact, particularly in its presentation of addresses by the Dutch sovereign.

One of the principal conclusions of this dissertation is that (with a few exceptions) the London Government was most successful when it utilized the services of persons or organizations already located in the occupied territory, rather than attempting to dispatch individuals to Holland or create such organizations from London. Among those examples supporting this postulate, in addition to the aid and contact organizations listed above, are three large armed resistance organizations, the clandestine press, and various resistance coordinating bodies. The England-Spiel episode is offered as negative proof, in that it represents an extensive activity planned and executed by London which ended in total disaster. As partial exceptions to the rule appear London intelligence agents who, for technical reasons, were alone able to arrange initial contact with England; London's creation of the Netherlands Forces of the Interior, a militia composed of members of the three largest armed resistance organizations; and the establishment by London of the College of Bondsmen, a resistance coordinating organization called into being to replace a locally formed organization in which a political deadlock existed.

Sources are largely official Dutch documents, the testimony of persons concerned, and published personal accounts. Microfilm \$4.80; Xerox \$17.10. 376 pages.

POLITICAL SCIENCE, PUBLIC ADMINISTRATION

A SURVEY OF HOUSING REHABILITATION PRACTICES AND THEIR IMPLICATIONS FOR URBAN RENEWAL

(Order No. Mic 61-2051)

William Wray Nash, Jr., Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. Chester Rapkin

Since the Housing Act of 1954, residential rehabilitation has been officially recognized as a method of improving the existing substandard housing stock, but almost no use has been made of the process in Federally aided urban renewal programs. This can be partly attributed to the scarcity of factual information, since previous studies in the field largely concentrated upon the partisan viewpoint of either

the investor and his profits or the public policy maker interested in general housing improvement. The present study has combined various approaches to the topic by collecting evidence with direct bearing upon the double question: under what circumstances does rehabilitation take place as a normal investment activity, and how can they be related to a community's housing program.

The method employed a detailed review and critique of secondary sources and a series of case studies based upon sixty-four intensive interviews conducted in ten cities during 1956-1957, with commercial rehabilitators, public officials, and interested bankers. These sources were supplemented by twenty-six questionnaires from rehabilitators largely located in other cities, by a selective sampling of demand characteristics for remodeled center city dwellings (conducted jointly by the American Council To Improve Our Neighborhoods and *Fortune* magazine), and by additional consumer interviews undertaken by the author in Washington D. C.

Attention was confined to urban rather than suburban areas, where the size and condition of the housing stock made rehabilitation particularly important, and to declining areas rather than those stable neighborhoods where what rehabilitation is undertaken can be considered a part of normal maintenance. In the descriptive portion of the study cases were presented in three major rent range categories corresponding roughly to a tertile distribution of family income. Among the more significant types of rehabilitation activity in deteriorating areas from the policy standpoint were: virtual reconstruction of center city slum units for the upper-income market, modest repairs to low-income units under local code enforcement programs, and voluntary remodeling to slightly higher standards for a "captive" minority group market.

In the remaining analytic portion of the study, the collected case data was assessed to determine what were the significant aspects of rehabilitation as a business activity. Each case was found to include a survey of market conditions, either informally or through a more formal market analysis; a process of cost estimating (representative cost figures are given); and a consideration of methods of financing. Rehabilitation was found to be profitable whenever potential rents (or sales prices) for improved units were enough above existing rents to assure a rate of return usually between 15 and 20 per cent of the investment. The analysis ended with a discussion of the roles of various levels of government and the techniques available to them in formulating long range housing goals: on the local level, application of police powers, provision of community facilities, taxing and assessment policies; on the national level, the several activities of the Housing and Home Finance Agency.

It was concluded that favorable market conditions for rehabilitation frequently were found to exist in overcongested areas containing basic neighborhood design deficiencies. While perpetuation of the existing housing patterns through rehabilitation can hardly be considered economically justifiable in these areas, the study suggests that an argument can be made for the short run alleviation of substandard housing conditions if lower standards of achievement are politically acceptable. The study ended with suggestions for stimulating rehabilitation activity, chiefly in the areas of adequate financing and in the provision of public facilities and services to aid in stabilizing deteriorating areas.

Microfilm \$4.10; Xerox \$14.40. 317 pages.

DEVELOPMENT OF ADMINISTRATIVE ADJUDICATION IN THE FEDERAL TRADE COMMISSION SINCE 1946

(Order No. Mic 60-5047)

Abelardo G. Samonte, Ph.D.
Princeton University, 1959

This study analyzes the basic features and growth of the adjudicatory process in the Federal Trade Commission. Informal procedures have played an increasing role in FTC adjudication. In the processing of alleged violations, many cases are closed for lack of merit; others are settled through informal stipulation or administrative treatment. Only a small percentage of the cases reaches the stage of formal complaint.

Moreover, the consent settlement procedure has replaced the traditional, adversary proceeding as the principal mode of adjudicating complaints. While all docketed cases in 1951 were contested, almost 80% of cease-and-desist orders issued in 1958 were based on consent agreements. Formal adjudication, nonetheless, is important for its deterrent effect and for the establishment of leading precedents.

The development of adjudicative processes in the FTC has been the product of many factors. Several innovations were made through agency initiative, usually stimulated by outside criticism and proposals. For instance, the adoption of the default order, pre-hearing conference, and consent settlement were separately recommended by various groups including the Attorney General's Committee on Administrative Procedure, the American Bar Association, and the President's Conference on Administrative Procedure.

Other procedural changes were the result of application by the Commission of the Administrative Procedure Act. Directly attributable to the Act is the increased status and independence of the hearing examiner. Functions handled directly in the past by the Commissioners are now exercised either concurrently or exclusively by the examiner.

With the institution of the initial decision, the substitution of examiners has been made with more discrimination; the assignment of cases, filing of briefs, and closing of the record have been regularized. At present, the examiner rules on almost every motion, and the Commission ordinarily rejects an interlocutory appeal unless there is clear abuse of discretion. The examiner's findings, while not conclusive, carry great weight in the Commission and in the courts. The incidence of appeal or review is high, despite the fact that a large majority of initial decisions are affirmed.

Adjudication at the commission level has been expedited by the rule of reassigning cases which have been on a Commissioner's table for more than 75 days and by discarding the practice of rewriting entirely the examiner's findings. Concurrently, opinions written by the Commissioners include a narrative statement of the case, the arguments of the parties, and reasons for the decision based on legal principles and past cases. This marks an improvement in terms of fairness and increased precedent-value of Commission decisions.

In exercising their adjudicatory functions, however, Commissioners are insulated by practice from the agency staff, except their respective legal aides and the division of special legal assistants. This practice seems to be based on a narrow interpretation of the provision of the

Administrative Procedure Act regarding separation of functions. It deprives administrative adjudicators of expert advice in the highly technical area of trade regulation.

As a whole, the time required for the adjudication of FTC cases have been considerably shortened. Room for improvement, however, exists. The problem of increasing work-load and backlog demands greater selectivity of cases to be prosecuted. Policy guides and standards should also be adopted by the Commission with a view to

minimizing the scattered, staggered nature of hearings, and to making more systematic and extensive use of pre-hearing conferences, depositions, written expert testimony, and other techniques for prompt, efficacious adjudication. For only through a positive and integrated approach to problems of monopoly and unfair or deceptive business practices can the FTC hope to attain successfully the goals for which it had been created.

Microfilm \$5.20; Xerox \$18.45. 406 pages.

PSYCHOLOGY

PSYCHOLOGY, GENERAL

A FACTORIAL STUDY OF "NEUROLOGICAL EFFICIENCY," PERCEPTION AND PERSONALITY.

(Order No. 61-3582)

Gilbert Howard Honigfeld, Ph.D.
Temple University, 1961

A variety of constructs have been invoked to account for individual differences observed in the areas of perception, personality, learning and intelligence. It is found that such concepts as "satiation," "reactive inhibition," "neurological efficiency," "cortical or cerebral efficiency," "metabolic efficiency," "cortical inhibition or conductivity," are applied in the description of a wide range of psychological phenomena. Several theorists, notably Eysenck, Klein and Krech, and Michael Wertheimer, have sought to unify psychological theory by the utilization of a single construct in the explanation of differences between individuals in a number of situations. For example, by recourse to his construct of "cortical inhibition," Eysenck is able to predict that extraverted persons should demonstrate greater perceptual figural aftereffects. The present study was designed to evaluate the feasibility of assuming that a common factor was significant in determining behavior in the diverse areas of perception, personality, and intelligence. If such a factor were to be found it was the secondary purpose of this investigation to evaluate the justification for assuming that this factor could reasonably be considered a "central" factor.

A battery of tests was administered to 105 male and female undergraduates. The perceptual measures included a number of indices of critical flicker frequency (CFF), the spiral aftereffect (SAE), autokinetic movement, apparent movement, and visual acuity. Several measures were taken under special viewing conditions arranged to maximize the contribution of "central" determinants of the phenomena. Nine scales of the Guilford-Zimmerman Temperament Survey comprised the personality measures. Intellectual ability measures used were the Scholastic Aptitude Test of the College Entrance Examination Board, the College Qualification Test, and the analogies test of Terman's Concept Mastery Test. Intercorrelations were computed between all 48 variables. On the basis of several

criteria 18 of these measures were considered unsuitable for further consideration. Consequently a reduced matrix of intercorrelations among the remaining 30 variables was subjected to a factor analysis.

The over-all hypothesis was that a factor common to the three major kinds of variables (perceptual, personality, and intelligence) would emerge. A second hypothesis was that the more intelligent or more extraverted subjects would behave differentially in the perceptual test situations. Lastly, it was hypothesized that as evidence of the "central" nature of the determinants of these phenomena, higher factor loadings would prevail for binocular rather than monocular CFF measures, and "monocular switching" rather than monocular viewing in the SAE test. For the apparent movement measures it was hypothesized that highest loadings would be obtained for the interocular viewing conditions, next highest for the binocular, and lowest loadings for the monocular conditions of viewing.

The results of the factor analysis yielded ten factors, no one of which could in any meaningful manner be considered a common factor of "neurological efficiency." A number of rather specific factors emerged, and even within the perceptual area less common variance was discovered than might have been expected. Factor I is an "intellectual ability" factor; Factor II is a perceptual "speed of resolution" factor; Factor III is concerned with both CFF and apparent movement; Factor IV is a "quality of adjustment" factor; Factor V is a limited "neurological efficiency" factor; Factor VI is exclusively a perceptual factor concerned with "Beta range" scores; Factor VII is a factor of "social boldness"; Factor VIII is an "introversion-extraversion" factor; Factor IX is a "fund of information" factor; and Factor X is concerned exclusively with autokinetic movement. No justification for the importance paid by Eysenck to the introversion-extraversion dimension of personality (Guilford's "R" scale) could be found. Moderate support was obtained for those studies which report a relationship between CFF and intelligence. In those cases in which the perceptual measures loaded on a factor, the order of factor loadings did not support the hypothesis that "central" processes were of primary importance. The most significant over-all conclusion seems to be that to attempt to ascribe individual differences in perception, personality, and intelligence to a common construct of central "neurological efficiency" is to over-simplify a complex set of observations. Microfilm \$2.75; Xerox \$5.80. 120 pages.

THE INFLUENCE OF RELIGIOUS LIFE
ON THREE LEVELS
OF PERCEPTUAL PROCESSES

(Order No. Mic 61-1571)

Sister Marie Francis Kenoyer, S.L., Ph.D.
Fordham University, 1961

Mentor: Joseph G. Keegan, S.J., Ph.D.

The present study investigated two questions about perceptual behavior: the extent of relationships among different types of "perception," and the influence of experience on perception. Perception was viewed as occurring on three "levels" defined by the instruments used to measure the perceptual processes: self-perception, by the ten subscales of the Guilford-Zimmerman Temperament Survey; perception of complex verbal material, by the Watson-Glaser Critical Thinking Appraisal; and sensory perception by three tests for flexibility of closure and two tests for speed of closure. The influence of experience was examined on each of the variables separately and on their interrelationships with one another.

The experience serving as the independent variable was that afforded by membership in a community of religious Sisters whose work was teaching. The 500 American-born white women comprising the total experimental sample were divided into six groups, an experimental group of religious and a control group of lay women at each of three stages of experience. The lay and religious groups at each stage of experience were matched for age, education, mental ability, and socio-economic level. The 180 women at stage three averaged 28 years of age, the religious averaging nine years of community living; the 140 women at stage two averaged 23 years of age, the religious averaging four years of community living; and the 180 women at stage one averaged 19 years of age. These young women at the first stage served as a special control in that neither group had actually experienced religious life; 90 of them, however, planned to enter a community of religious teaching Sisters within a year. Differences among groups in each of the variables were determined by analyses of variance and planned comparison of means.

By a comparison of the two groups at stage one, it was determined that young women who planned to enter religious life (previous to any experience in actually living the life) already perceived themselves as more emotionally stable, less inclined to be hypersensitive, more cooperative, and more masculine (according to GZTS scores) than did the lay women; and that they had less facility in organizing the visual stimuli constituted by the Gestalt figures. A comparison between stage one, young women in late adolescence, and the other two stages, adult women, identified differences due to age and experiences common to Sisters and lay women. The older groups of women perceived verbal material more accurately, as shown by higher scores on the W-G CTA, and perceived themselves as more self-controlled, agreeable, and masculine, as shown by GZTS scores, than did the nineteen-year-olds.

The actual influence of religious life was clearly shown in two of the 16 variables. As indicated by scores on the GZTS subscales Ascendancy and Sociability, religious life seems to result in a self-percept having more qualities of submissiveness and shyness than are present in the self-percept of the lay woman.

When the influence of religious life on the interrelationships among the variables was investigated by means of centroid factor analysis and orthogonal rotations, it was found to be minimal. Four factors common to lay and religious groups appeared when the scores of the 160 Sisters and 160 lay women who constituted the two older groups were separately factor analyzed. Experiential influence could be postulated for slight differences in patterns within the level of self-perception, and for the appearance of one distinguishing factor; but similarities between Sisters and lay women are much more pronounced than are differences.

This study contributed to the knowledge of experiential influence on perception by showing that religious life as exemplified in teaching Sisters, clearly influences only two areas of self-perception, and that increase in age and general experience influence other areas of self-perception and the perception of complex verbal material. It has not found relationships between self-perception and the other levels of perception treated in this investigation, nor does it give evidence of any specific patterning of perceptual behavior as a result of experience in a religious teaching community. Microfilm \$2.75; Xerox \$7.60. 161 pages.

A STUDY OF THE NATURE
OF GUILT IN PSYCHOPATHOLOGY

(Order No. Mic 61-2835)

Carrington Marshall Lowe, Ph.D.
The Ohio State University, 1961

While the nature of guilt has been of interest to theology, psychoanalysis, and increasingly to academic psychology, there is no agreement as to what guilt is or to what it is due. As a result, a measurable or operational definition of guilt has been lacking. Such an attempt at operational measure is made in the study.

After the conclusion was reached that the different theoretical constructs of guilt require different operational measures, scales were devised to measure three different kinds of guilt. The first type of definition, which equates guilt with wrongdoing, or the actual and tangible violation of social sanctions, was measured by a scale using some thirty-one questions from the Minnesota Multiphasic Personality Inventory, the answers to which imply social wrongdoing. The second type of definition equates guilt with remorse or regret, which causes the person concerned to have feelings of guilt. This definition was measured by a scale of fifty MMPI items, subscales of which measured need for punishment, obsessive thoughts, depression, lack of self-worth, and anxiety. The third type of definition was in terms of discrepancy guilt, which is the difference between one's ideals and his perception of his own actual behavior, as measured by Q-sorts.

Since guilt has been considered both as cause and as a result of mental illness, the measures of guilt were administered to three groups of subjects, two of whom were psychiatric patients at the Chillicothe, Ohio, VA Hospital. One group consisted of patients considered to be psychotic, and the second group of patients who were non-psychotic but who were suffering from a functional emotional disturbance. The third, or normal group, was

made up of employees of the hospital. Seventy-five subjects were divided equally between the three groups.

It was hypothesized first that different theoretical constructs of guilt are sufficiently alike that the three measures of guilt would be significantly related to each other. This hypothesis was only partially confirmed. The intercorrelations are significant statistically, but they are fairly low, and part of the significance is lost when defensiveness and social desirability are partialled out. Furthermore, these relations are dwarfed by the high intercorrelations of the different sub-scales of the measure of feelings of guilt, which as a total scale correlate +.94 with the Pt or Psychasthenia scale of the MMPI.

Secondly, it was hypothesized that the most guilt would be found among the psychotic patients and the least among the normal group, with non-psychotic psychiatric patients occupying an intermediate position. This hypothesis also was confirmed in part. The measure of feelings of guilt effectively differentiated between patients and non-patients, but not between psychotic and non-psychotic patients. The Q-sort discrepancy between ideal and actual behavior differentiated between the two patient groups, but not between non-psychotic patients and normal subjects. The measure of actual wrongdoing did not successfully differentiate the three groups.

Although the study found a close relationship between guilt and generalized anxiety and depression, it was impossible to state whether guilt is the cause of emotional disturbance or whether it is merely a symptomatic by-product of it. Thus the results were discussed both from the standpoint of the psychoanalytic view that depression results from a pathologically severe superego and from a diametrically opposite viewpoint, which states that social wrongdoing causes a shame which is self-isolating and ruptures ego-involvements. Within the latter frame of reference, guilt was considered as that disease of the self-concept which results from alienation from core values.

Microfilm \$2.75; Xerox \$4.20. 80 pages.

PSYCHOLOGY, CLINICAL

RESPONSE SETS AS INDICATORS OF SENESCENCE AND OF PSYCHOPATHOLOGY IN OLD AGE

(Order No. 61-2995)

D. Geraldine Boozer, Ph.D.
Louisiana State University, 1961

Supervisor: Professor Irwin A. Berg

The aims of the present study were twofold: (1) to test the Deviation Hypothesis by extending its application to old age populations, and (2) to gain some insight into the personality and problems of the aged. The Deviation Hypothesis (Berg, 1957, 1959) states: "Deviant response patterns tend to be general; hence those deviant behavior patterns which are significant for abnormality... and thus regarded as symptoms... are associated with other de-

viant response patterns which are in noncritical areas of behavior and which are not regarded as symptoms..."

For the current purposes, deviant response patterns were defined as those which depart significantly from the responses of a criterion group. The procedure involved searching for differences in response patterns between specified groups of aged persons and certain groups of younger persons. The test used to elicit deviant responses was the Perceptual Reaction Test (Berg, Barnes, and Hunt, 1949). The data consisted of the test records of 602 aged Ss, sub-divided into the following groups: non-institutionalized persons, mental hospital patients, and persons living in homes for the aged; and 2056 younger adults consisting of groups of assumed normal persons, mental hospital patients, and schizophrenic Ss.

The foregoing groups were compared with each other in different combinations and by means of various measures of deviant response sets. Measures of intra-individual variability were also employed in order to ascertain the extent to which Ss within these groups tend to cling to their own response patterns.

The results indicate that the Deviation Hypothesis may be generalized to old age groups. It was possible, on the basis of measures of intra-individual variability and differential response sets, to discriminate significantly between all of the groups included in the present study. The findings were used to construct objective and valid scales which are hypothetically valuable in assessing senescence. It was shown that, on the basis of deviant responses, scales might be developed which would identify psychopathological conditions characteristic of old age persons.

Although all of the groups here included manifested significantly different response patterns, there were indications that some personality characteristics may be common to certain groups, although not to the same extent. Aged persons, schizophrenic younger adults, and children, for example, appear to show response sets that are in the same direction, i.e. different from those of normal younger adults. Aged and younger mental hospital patients also appear to manifest response sets that in similar directions, i.e. away from those of normal younger adults. In general, however, whenever groups of aged persons were compared with groups of younger adults, the aged Ss appeared to be by far the most deviant in their response patterns, and also the most deviant in terms of intra-individual variability in response sets. The aged groups were significantly less variable than the younger, and the aged mental hospital patients, the least variable of all.

It was concluded that scales developed from deviant response sets provide more objective measures of personality than have heretofore been constructed with respect to aged persons. The scales, as well as knowledge about characteristic patterns of response of various aged populations, should be of value in differential diagnosis and commitment criteria of institutions caring for the aged. Such knowledge might also be useful in interpreting results of tests developed on younger persons and administered to aged persons. Personality theorists may also wish to encompass in their constructs the implications of the data here obtained, that personality changes with old ages.

Microfilm \$2.75; Xerox \$6.40. 132 pages.

RISK-TAKING BEHAVIOR OF SCHIZOPHRENICS AND NORMALS

(Order No. Mic 61-716)

David Warren Briggs, Ph.D.
Boston University Graduate School, 1961

Major Professor: Henry Weinberg

The aims of this study were: (1) to test whether hypotheses regarding the behavior of schizophrenics which had received support in level of aspiration studies would also be supported by decision theory type chance taking measures; and (2) to examine the kinds of risks toward which schizophrenics were most sensitive.

Two theoretical models, decision theory and level of aspiration theory, dealing with decision making in situations involving the threat of failure, were shown to be basically similar to their formulation; they differed, however, in regard to the independence of probability and reward, and the degree of the individual's control over the outcome and the motive of achievement. "Risk," which was considered to be the objective equivalent of the clinical concept "threat of failure," was defined operationally as the negative term of the expected value model (i.e., as the product of the probability of loss and the amount of possible loss).

The schizophrenic reaction was formulated as a withdrawal from the threat of failure which results in a deficit in mental functioning. Withdrawal was interpreted to include denial of the existence of threat. From this formulation it was predicted that schizophrenics would more frequently select the extremes of risk and thus less frequently select the middle level of risk than would normal individuals. In addition, hypothesizing that the paranoid schizophrenics were more likely to deny the existence of threat, it was predicted that of the schizophrenics the paranoids would more frequently select the greater risks. In addition a number of exploratory questions were asked regarding the kinds of risk, both in quality and degree, on which schizophrenics would differ from normal individuals.

The experimental group was composed of 35 chronic, male schizophrenics with WAIS Vocabulary standard scores of 10 or over. Subgroups of 12 paranoid and 13 clearly non-paranoid schizophrenics were used for testing the second prediction. The control group of 35 subjects was equivalent to the experimental group in gender, age, amount of education, and mean Vocabulary score. Three dice games, modeled after Ward Edwards' measures of probability-preferences in gambling, and a Risk Preference Inventory were utilized as measures of risk-taking behavior. The data from these measures were analyzed in several ways: (1) The levels or degrees of risk within each measure were examined independently. (2) Over-all trends across levels within each measure were examined by the systematic *a-priori* weighting of the levels. These trends were: a) the tendency to prefer the middle as opposed to the extreme levels of risk and b) the tendency to prefer the low as opposed to the high extremes of risk. Subscales measuring different kinds of risk-taking situations and a scale of conformity to the common responses made by the majority of subjects were also developed from the Inventory.

The results supported the first prediction, that schizophrenic subjects would less frequently choose alternatives

representing middle levels of risk, but not the second prediction, that paranoid schizophrenics would more frequently choose high levels of risk than non-paranoids. The results which support the first prediction are congruent with the findings from level of aspiration studies. It was also found: (1) that schizophrenics more frequently choose the lower levels of risk when there is a possibility of a definite loss (which represents a direct avoidance of risk), (2) are more sharply distinguished from control subjects in this respect where the situations involve achievement and work rather than purely chance and gambling situations (which suggests that self-esteem is an important variable in determining the subjective threat felt in a risk-taking situation), and (3) deviate more from the common responses of the majority of subjects (which implies a deficit in judgment or comprehension).

Microfilm \$2.75; Xerox \$7.60. 162 pages.

A QUANTITATIVE SYSTEM FOR ASSESSING THE INTENSITY OF PSYCHIATRIC COMPLAINTS

(Order No. 61-3060)

Lois Rommel Chatham, Ph.D.
University of Houston, 1961

The aim of this investigation was the development of a method or technique which would accelerate pretreatment assessment of psychiatric patients. Investigation revealed that the complaints of the patient were the most accessible, most unusual, and perhaps most meaningful measures of behavior available for study. A two-dimensional system for classifying patients' verbalized complaints was constructed using the Q-Sort technique. The scale could be administered quickly and reliably by clerical assistants, and converted patient complaints into a reliable, meaningful complaint portrait. The array yielded statistical weightings indicating complaint importance and could be interpreted at a glance by the examining clinician. Its advantages were the following:

- (1) Complaints were easily and uniformly elicited.
- (2) Complaints were arranged into a forced normal distribution.
- (3) The method eliminated interviewer bias.
- (4) The examining clinician was provided with a refined and yet reliable picture of how the patient viewed his difficulties prior to the first interview with the patient.

The scale, called The Psychiatric Complaint Intensity Scale, was developed in three phases. The first phase was investigatory and consisted of a statistical analysis of the complaints of 200 outpatients who were seen during the first two years of operation of the Malcolm Bliss Psychiatric Clinic. Phase II quantified all the data from Phase I, organized the material, and adapted it to the Q-technique. The reliability of the resulting Q-sort was then checked by statistical analysis of a sample test administered to a group of 50 widely varying subjects. The subjects for the reliability check included professionals as well as patients. The result was an internal validity of .8643. Phase III

consisted of two applications of the scale. The results of Phase III showed the usefulness of the scale, as both a clinical and a research tool. The first study consisted of the application of the scale to 25 aging outpatients selected in order of arrival at the clinic. The purpose of this research was to ascertain the existence of age-linked complaints. The second population was made up of psychiatrists, psychologists, and social workers. The purpose here was to determine if the unequal professional training given to people in varied mental health disciplines results in constant perceptual bias. The following conclusions were reached:

- (1) The scale provided a reliable means of assessing patient complaints.
- (2) The scale could be used even with seriously disturbed patients.
- (3) The scale yielded a reliable, statistically weighted, complaint array and remained free of internal bias.

When the scale was applied to a group of aging persons, the following was learned about the behavior of complaining in the aging. While in general there is little homogeneity in complaint patterns of aging patients over 45 years of age, some patterns did emerge:

- (1) The youngest of the aging group, 45-50, showed a statistically high emphasis on mental health complaints in comparison with the two older groups.
- (2) The oldest group (56 and over) showed significantly greater emphasis on reality disturbance. They also showed significantly less emphasis on somatic complaints.
- (3) Anxietal complaints, in general, were emphasized significantly more by all groups in comparison with other complaint areas, while reality disturbance complaints were emphasized significantly less.

In a cross-disciplinary study, significant bias on given complaint areas was found to exist among psychologists, psychiatrists, and social workers when they were asked to sort complaints according to importance. The bias was not present, however, when this same group assessed the importance of complaints being made by a "live" patient. The bias present in the theoretical sorts disappeared as a function of the experience of the individual and was independent of his earlier training or professional identification. Microfilm \$2.75; Xerox \$3.60. 65 pages.

DIFFERENTIAL BEHAVIORAL EFFECTS OF EMOTIONAL FACILITATION FROM CENTRAL AND PERIPHERAL STIMULATION

(Order No. 61-3056)

Noble Dewey Enete, Ph.D.
University of Houston, 1961

Problem. Results arising from brain stimulation studies have led investigators to speculate on the similarity and differences between the behavioral effects due to brain stimulation and those due to peripheral stimula-

tion. The literature on brain stimulation studies show that the reticular system and its ramifications are critical for the facilitation of centrally elicited behavior. Within this energizing system, there are loci mediating highly non-specific activation effects, antagonistic restitutive effects, and specific facilitation of well-organized patterns of adaptive behavior.

The purpose of this study is to make a clearer distinction between the effects of central and peripheral activation. Differential effects of timing relations were noted in many studies dealing with central and peripheral activation effects. The hypothesis developed was that central and peripheral activation effects could be distinguished in terms of their temporal contiguity with a response and their temporal duration.

Method. Central arousal effects were produced by electrical stimulation through electrodes chronically implanted in critical loci of the reticular activating system. Bipolar electrodes were placed in the posterior and anterior regions of the hypothalamus of rhesus monkeys.

Presurgical training was conducted in a Foringer primate chair until the subjects were able to perform a stable bar-pressing response to glucose pellets. Postsurgically, they were retrained to food pellets until they reached a stable rate of response on a variable interval schedule of 60 seconds.

The effects of temporal contiguity on centrally elicited behavior was tested by differential rates of bar-pressing responses on two schedules of reinforcement. One schedule was a VI-60" in which the intracranial stimulus was contingent on a response and the other was a VI-60" where the same number of brain shocks was delivered irrespective of bar-pressing responses. The posterior placement was the site of activation for this phase of Situation I. Each running session was for four hours with two hours on the contingent schedule and two on the noncontingent. These sequences were counterbalanced on each successive day. The two schedules were presented in exactly the same way with food reward.

In Situation II, duration effects were tested by presenting trials consisting of ten-minute periods of continuous reinforcement followed by no reinforcement to an extinction criterion of three consecutive minutes with no response. Food reward and posterior stimulation were alternated on consecutive days.

Results. Postsurgical verification of electrode placements showed posterior placement stimulation to have an arousal effect as defined by EEG, autonomic, and behavioral measures of activation. Anterior placements yielded depressed levels of activation as defined by the same measures.

The following results were found for Situation I:

1. For posterior placement self-stimulation, no difference was found between the contingent and noncontingent schedules of reinforcement.
2. For food reward, the response rates on the contingent schedule were significantly higher than on the noncontingent schedule.
3. Response rates with food and posterior stimulation were significantly higher than operant level.
4. Response rates with food were significantly higher than with posterior placement stimulation.

The results for Situation II were:

1. With posterior stimulation, responses on continuous reinforcement decreased with progressive trials whereas with food, they increased.
2. Progressively more time was required to reach an extinction criterion of no responding for three minutes with posterior stimulation as compared with food reward.
3. Progressively more responses were required to reach the extinction criterion with posterior stimulation as compared with food reward.
4. A more stable measure of this trend was noted using the ratio of reinforced responses over extinction responses. As trials progressed, the ratios became successively smaller with posterior self-stimulation whereas they became larger with food reward.

Conclusions. The behavioral effects of brain stimulation and peripheral stimulation could be distinguished on the basis of their temporal relationship to the response. No difference between the contingent and noncontingent schedules was obtained when bar-pressing was induced by posterior stimulation. When activation was aroused by internal and external sensory cues in the food situation, discrimination between the contingent and noncontingent schedules was readily developed.

Such a phenomenon could be attributed to the longer lasting duration of activation when aroused by nonspecific posterior stimulation as compared with food. This hypothesis of duration effect was tested with confirmation of the prediction. With posterior stimulation, not only did responses show a resistance to extinction, but there was an actual increase in the number of responses during extinction and in the time it took the animal to extinguish. With food reward, a temporal discrimination was developed as shown in the increased response rates under reinforcement while extinction time and rates decreased with progressive trials.

An optimal state of arousal, or emotional facilitation is indispensable for the acquisition of patterns of behavior. When this state is induced by central stimulation devoid of sensory cue effects, though it may facilitate ongoing behavior, it produces no appreciable increment in discriminative learning. The arousal process must interact with sensory cues, both interoceptive and exteroceptive, before it can presumably have any effect on discriminative learning. This study supports the hypothesis of a generalized activation or facilitative system which when interactive with sensory input and an ongoing response sequence directly affects learning and performance.

Microfilm \$2.75; Xerox \$6.60. 140 pages.

SOME EFFECTS OF SUBJECT-EXAMINER INTERACTION ON THE TASK PERFORMANCE OF SCHIZOPHRENICS

(Order No. 61-3580)

Antonio Felice, Ph.D.
Temple University, 1961

Recent research evidence has indicated that the performance deficit seen in schizophrenia is a selective process which is partly a function of interpersonal vari-

ables. Psychological and psychiatric writers have also noted the sensitivity to scrutiny and possible censure shown by schizophrenics. The present study attempted to investigate the hypothesis that the interpersonal nature of the psychological testing procedure adversely affects the task performance of schizophrenics. This assumption was translated operationally into experimental method by testing a group of schizophrenics and a group of nonpsychiatric patients, with half of each group assigned randomly to one of two testing conditions, defined as interpersonal and impersonal. In the interpersonal condition the examiner administered the experimental tasks to the subjects, read the directions to them, and remained in the testing room interacting with the subjects throughout the procedure. In the impersonal condition, the subjects, after initial directions, were left alone in the room to complete the tests, read test directions from a typewritten page, but were observed through a one-way-vision mirror.

The two independent variables were type of subject (schizophrenic vs. nonpsychiatric) and testing condition (interpersonal vs. impersonal). Four experimental groups were thus formed: (a) schizophrenic interpersonal, (b) schizophrenic impersonal, (c) nonpsychiatric interpersonal, and (d) nonpsychiatric impersonal. Dependent variables were measures of task efficiency on four experimental tasks. The hypotheses under test predict less task efficiency for the schizophrenic interpersonal group than for the schizophrenic impersonal group, but no difference in task efficiency for the nonpsychiatric subjects under the two testing conditions.

The Gates Reading Survey (Speed and Accuracy Test) and an intelligence measure (Shipley-Hartford vocabulary) were administered in that order as part of the screening procedure. The Ferguson Formboards (yielding a time and a score measure), Gorham Proverb Test (score), Concept Sorting Test (yielding a score based on conceptual sorting of 16 cards according to color, form, and number of figures), and Mirror Drawing (time and error measures) were the four experimental tasks. The sequential order of Formboards, Proverbs, and Sorting was counterbalanced, but Mirror Drawing was always administered last because of its frustrating nature.

Subjects were Caucasian, male patients in a Veterans Administration Hospital. The schizophrenic subjects were selected from the open neuropsychiatric wards and the nonpsychiatric subjects from the medical-surgical wards. The four experimental groups were equated for age, education, vocabulary, and reading scores. Statistical treatment of the data consisted of a 2 x 2 analysis of variance for each test measure. Critical difference, *t*, and *F* tests were used to evaluate differences between groups, where appropriate.

The findings were that over-all differences in task performance were more clearly associated with whether or not the subjects were schizophrenics than with the impersonal-interpersonal testing dimension, or its interaction with the type of subjects. Although partial support of the hypothesis that schizophrenics perform less efficiently in the interpersonal condition was found, it was noted that subject-examiner interaction did not affect all of the types of tasks investigated. Support for the hypothesis of a differential reaction by schizophrenics to the interpersonal testing condition was found with regard to Ferguson Formboards performance, but not on the other three tasks. Subject-examiner interaction detrimentally affected the

subjects' performance on the two motor tasks investigated: performance of the schizophrenics on the simpler of the two tasks, the Formboards, and performance of the non-psychiatric subjects on the more complex and frustrating of the two tasks, Mirror Drawing. Thus, it was noted that the deficit observed is partly a function of the presence of schizophrenia and partly a function of a complex interaction among presence of schizophrenia and situational variables, such as type of performance required by the task and subject-examiner interaction.

Microfilm \$2.75; Xerox \$6.40. 131 pages.

A Q-TECHNIQUE STUDY
OF THE SELF-CONCEPTS OF TWO GROUPS
OF COLLEGE STUDENTS VARYING IN
DEGREE OF SPEAKING ABILITY

(Order No. 61-3327)

Robert Joseph Ferullo, Ed.D.
Boston University School of Education, 1961

PROBLEM: To ascertain the congruence of the self-concept relationships and personality trait areas of better and poorer college speakers within the theoretical framework of self-concept theory as it has evolved from experiences in client-centered therapy.

SCOPE: The subjects constitute two groups of thirty college students each, representing better and poorer speakers, who qualified to become subjects in this study from a larger group of two hundred college students. All subjects were nonspeech majors enrolled in a required course in public speaking at Northeastern University, Boston, Massachusetts.

PROCEDURES: The selection of better and poorer speakers was based on scores obtained on the Bryan-Wilke Speech Scale in three different speaking situations. The self-assessment instrument utilized was a Q-sort of one hundred self-referent statements which was patterned after a similar instrument developed by Wallen.¹ A panel of five experts structured the Q-sort items into six personality trait categories: (1) Self-Acceptance, (2) Independence, (3) Self-Rejection, (4) Dependence, (5) Lack of Emotional Control, and (6) Withdrawal.

Each subject was asked to perform three specific self-sorts, i.e., the actual-self sort, ("how I think the statements describe me as I am"), the ideal-self sort, ("how I think the statements describe me as I would like to be"), and the "others"-self sort, ("how I think the statements describe me as I think others see me"), along a continuum "describes me the least" to "describes me the most." The sorts were administered in randomized fashion. Correlation coefficients were computed for the actual-self/ideal-self sorts and the actual-self/"others"-self sorts for both groups employing an adaptation of the Pearson product-moment correlation formula. Correlation coefficients were transformed into Fisher's z equivalents. Scores were obtained for the personality trait categories as contained in the actual-self sort. The mean correlation scores for the self-sort relationships and the mean scores

of the personality trait categories were tested for significance by means of small sample parametric methods.

The reliability of the trait categories was established by a re-categorizing of the items by the same group of experts following a four-week period. Total category reliability was .867.

The reliability of the total Q-sort instrument was established by the test-retest method. The total instrument was administered to a random sample of sixteen subjects (eight poorer and eight better speakers) following a four-week period. The obtained mean r was .604.

RESULTS: The results indicate that the following statements may be made:

- (1) The better speakers revealed a higher mean score for their actual-self/ideal-self concept relationship than did the poorer speakers for the same relationship.
- (2) The better speakers' actual-self/"others"-self concept relationship was significantly higher than their actual-self/ideal-self concept relationship.
- (3) The better speakers revealed a higher mean score for their actual-self/"others"-self concept relationship than did the poorer speakers for the same relationship.
- (4) The poorer speakers' actual-self/"others"-self concept relationship was significantly higher than their actual-self/ideal-self concept relationship.
- (5) Poorer speakers exhibited a significantly lower mean score for the personality trait categories of Self-Acceptance and Independence, and significantly higher scores for the trait categories of Lack of Emotional Control and Dependence.
- (6) Poorer speakers did not exhibit significant differences from the better speakers in terms of the mean personality trait scores for the categories of Self-Rejection and Withdrawal.

The fact that coefficients of correlation for the self-concept relationships were rather low should be considered when interpreting the foregoing results.

CONCLUSIONS: On the basis of the foregoing self-concept analyses, better speakers reveal a significantly higher degree of self-satisfaction, self-acceptance, independence, emotional control, and personality integration than do poorer speakers. Contrary to previous studies, no difference was found in the personality trait category of withdrawal. Finally, the self-concept theory appears to be a useful framework for research concerning the personality patterns of college-age populations.

1. Vincent Wallen, A Q-Technique Study of the Self-Concepts of Adolescent Stutterers and Non-Stutterers, unpublished doctoral dissertation, Boston University, 1959. Microfilm \$2.75; Xerox \$8.00. 175 pages.

THE PSYCHODIAGNOSTIC EFFICIENCY
OF WAIS AND RORSCHACH SCORES:
A DISCRIMINANT FUNCTION STUDY.

(Order No. Mic 61-712)

Robert Lee Geiser, Ph.D.
Boston University Graduate School, 1961

Major Professor: Charles N. Leef

This study investigated the efficiency of a limited number of conventional psychological test scores from the Wechsler Adult Intelligence Scale and the Rorschach in discriminating among three groups of patients who varied in level and kind of psychopathology. Previous studies have approached the problem from a univariate standpoint and have utilized conventional nosological categories as criterion groups. The present study differs from previous work in two ways:

- (1) It has utilized multivariate rather than univariate techniques of analysis and,
- (2) It has systematically attempted to limit the degree of heterogeneity within the psychiatric criterion groups.

Two psychiatric groups of twenty patients each were selected from out of a much larger number of patients who were rated on the Wittenborn Psychiatric Rating Scales, which consists of nine factorially-determined scales. Each person's profile was matched with his own group and contrasted with members of the other group through the use of the D^2 statistic. This enabled the homogeneity within a group and the heterogeneity between the groups to be controlled. The two groups differed primarily in the level of pathology (roughly Neurotic and Psychotic). A third group of twenty hospitalized medical and surgical patients served as controls.

Each patient was tested with the WAIS and the Rorschach. Eleven WAIS and nine Rorschach scores were selected. The Rorschach scores were chosen on the basis of their ability to discriminate among the groups in an unilinear test of significance.

The matrix of intercorrelations among the WAIS and Rorschach variables was factor-analyzed in order to achieve a smaller set of (canonical) variates that would contain the bulk of the information in the original variables. The principal-components method of analysis was used; all twenty factors were extracted.

This smaller set of variates was used as the data for a discriminant-function analysis. Two discriminants resulted, both of which were significant. The two psychopathological groups and the Controls could not be contained along an unilinear dimension. The two discriminate scores for each person were plotted in discriminant space and group classification undertaken. A total of 92 per cent of the subjects were classified correctly, leading to the conclusion that when criterion groups are sufficiently homogeneous, psychometric data can be successfully used in discrimination among the groups.

An additional study was done which involved 7 Controls, 9 Open Ward, and 8 Closed Ward patients. The psychiatric patients in this sample could not be rated, since most of them had left the hospital. Instead clinical judgment of the nature and extent of the pathological behavior was substituted. Discriminant scores were calculated for these persons, using the weights already derived in the initial study. Classification was only 38 per cent accurate. This

was not significantly different from chance expectations, and grossly discrepant from the original results.

An analysis of these additional subjects revealed that two of the groups did not resemble their counterparts in the original study. The new Control sample had a significantly lower mean IQ level than the original sample of normals. The Open Ward group was found to be quite heterogeneous in the nature and extent of pathology, in spite of the attempts to select a homogeneous group.

Six of the obtained factors were rotated for psychological interpretation and tentatively named. The first two factors loaded mainly on WAIS subtests and were named Verbal Intelligence and Performance Intelligence. The other four factors did not contain enough test variable weights to adequately identify the factors. Though these factors were not named, two of the factor patterns appeared most typical of the Open Ward group, one of the Control group, and the other of the Closed Ward group.

The two discriminants, though not rotated, were tentatively suggested to be: (1) a general intelligence dimension of primarily WAIS subtests, and (2) a Rorschach dimension which seemed to contrast the richness and sterility of the protocol.

It was concluded that when psychiatric groups are internally homogeneous, as determined by operationally-defined, objective procedures, conventional psychometric measures can discriminate among the groups with a high degree of accuracy.

Microfilm \$2.75; Xerox \$8.80. 192 pages.

THE ATTITUDES OF MOTHERS TOWARD
INSTITUTIONALIZED AND NON-INSTITUTIONALIZED
RETARDED CHILDREN

(Order No. Mic 61-2554)

Max Klausner, Ph.D.
New York University, 1961

Chairman: Professor Howard M. Newburger

Purpose

The purpose of this study has been to compare mothers of retarded children residing at home with mothers of retarded children placed in institutions, on the basis of personality traits and child-rearing attitudes.

The specific problems considered were: (1) to appraise the attitudes of dominance, possessiveness, and ignoring for both study groups, and (2) to evaluate some personality traits for these two groups. Traits under investigation were: aggression, emotional instability, anxiety, immaturity, ambivalence, conflict, and depression.

The Need for the Study

While some studies have focused on the retarded child, the parent attitudes toward these children have been sadly neglected. This study has attempted to ferret out clues to the general traits of these parents and sought to discover whether any relationship existed between such variables and the important problem of institutionalizing the mentally defective child.

Procedure

The two comparison groups consisted of fifty mothers of institutionalized retarded children and fifty mothers of non-institutionalized retarded children drawn from various parent organizations, such as the Association for the Help of Retarded Children, Inc. These parent groups were located in the New York metropolitan area; and the selected subjects were matched for race, religion, education, and family income. Their children were matched for age, sex, grade of retardation, and the number of siblings in the family. They were tested on the Shoben Parent Attitude Survey, consisting of eighty-five items of dominating, possessive, and ignoring categories, and on the Bender-Gestalt Test, a visual motor technique designed to appraise a number of personality traits.

Results

In using three types of item analysis, both parent groups were significantly differentiated on eighteen items of the Shoben Scale. These statements were chiefly concerned with dominating attitudes or the need to control and direct the behavior of the child. The parents of the non-institutionalized retarded children indicated a greater tendency to agree with such dominating statements than the parents of institutionalized retarded children. In regard to dominating attitudes, both study groups were significantly different, but no significant differences were found in the categories of possessiveness and ignoring. A cluster analysis, in which four psychologists sorted eight of these items into the three categories of measures of control, intellectual objectivity, and warmth of relationship, indicated that the non-institutional group of parents showed more restrictive and negative child-rearing practices than the institutional group of parents.

Administration of the Bender-Gestalt Test yielded significant differences in the traits of immaturity and depression. The parents of the non-institutional group seemed to indicate less feelings of depression and fewer signs of immaturity than the institutional subjects. Both study groups revealed a high degree of emotional instability or impulsivity.

Conclusions

1. On the basis of weighted scores, both study groups differed significantly in attitudes of dominance. No significant difference was found in attitudes of possessiveness and ignoring, although the "t" test for the possessive category barely fell short of significance.
2. A total of eighteen differentiating items discriminated between the two comparable groups when three types of item analysis were applied.
3. The trait of emotional impulsivity existed to a high degree for both study groups.
4. The two study groups differed significantly in the traits of immaturity and depression. The non-institutional group indicated more mature attitudes and less of a tendency to suffer from depressive states than the institutional group.
5. Both study groups indicated healthier personalities than had been expected.

Applications and Recommendations

In working with parents of retarded children, the counselor can look for and point out those factors that have to be strengthened to restore the original adjustment of these individuals. The researcher who is interested in this field may have a better understanding of parents of retarded children and a more satisfactory insight into the parental attitudes that influence the decision to institutionalize the retarded child.

Microfilm \$2.95; Xerox \$10.35. 227 pages.

CHANGE IN SOCIAL DESIRABILITY RESPONSES AS A FUNCTION OF DIRECT INSTRUCTIONS, VERBAL REINFORCEMENT, ROLE PLAYING, AND COUNTER-CONDITIONING.

(Order No. 61-3134)

Mark Henry Lewin, Ph.D.
The University of Wisconsin, 1961

Supervisor: Associate Professor Barclay Martin

The present study was designed to investigate the differential and persisting effects of eight variables and a control condition upon the tendency to describe oneself in a socially acceptable manner on the Lewin Social Desirability Scales (LSDS), four alternate forms of a paper and pencil questionnaire devised especially for this study. The variables selected for investigation were direct instructions to respond in either a socially desirable or socially undesirable manner, verbal reinforcement for responding in either a socially desirable or undesirable manner, role playing in either direction, and direct instructions to respond in either direction with verbal reinforcement administered for responses in the opposite direction.

Nine treatment groups of 16 subjects (Ss) each were approximately matched on the basis of period one scores on the LSDS. Scores for each S were also obtained during the treatment period, immediately subsequent to the treatment period, and one week later.

The results indicate that opposite poles of a personality trait may function as different response classes. For example, the attempt to manipulate Ss in the socially undesirable direction on the LSDS resulted in greater and more persistent change in the predicted direction than did the attempt to manipulate Ss' scores in the socially desirable direction. This finding was not a function of initial social desirability level nor of differential degrees of reinforcement received by the treatment groups. Instead, it was interpreted as resulting from the differential ease of conditioning different response classes such as training people to be more honest about themselves in contrast to training them to create a near perfect self description.

The study also indicated that, although subtle verbal reinforcement is a more laborious means of manipulating individuals' attitudes than is direct instructions, it has different and more persisting effects than does direct instructions. In fact, only the condition undesirable group manifested a mean change score significantly lower than that of the control group during the final experimental period, one week after the treatment session.

The analyses of the instruct and counter-condition

groups indicated that verbal reinforcement for responses opposite to direct instructions resulted in marked reduction in the effects of the instructions in both counter-conditioning groups.

Results regarding the role play groups were equivocal. The role play undesirable group did not manifest a significantly different mean change score from the control or role play desirable groups during the treatment or final periods, but did score lower than both groups during the third experimental period. The role play desirable group never differed significantly from the control group, and manifested a significantly higher mean change score than the role play undesirable group only during the third experimental period.

Microfilm \$2.75; Xerox \$4.40. 81 pages.

**MANAGEMENT OF AGGRESSION IN
PREADOLESCENT GIRLS:
ITS EFFECT ON CERTAIN ASPECTS
OF EGO FUNCTIONING.**

(Order No. Mic 61-2751)

Mae Lee Maskit, Ph.D.
University of Michigan, 1961

This study explored relationships among three general sets of variables: (1) management of aggressive impulses, (2) accuracy of immediate recall of aggressive social situations, and (3) intelligence and social class. Management of aggressive impulses was determined by the subjects' willingness to admit aggression compared with aggression in fantasy and behavior.

The subjects consisted of sixty sixth-grade public school girls. Aggression admitted to awareness was determined by means of a self-descriptive check list, and a self- and ideal-self-rating scale, which were especially devised to tap aspects of aggression. The subjects also described themselves in a series of ten spontaneous statements. In order to measure aggressive needs about which the subject may not be able to admit to others or to herself, two projective measures were used: (1) the Rosenzweig Picture-Frustration Study, and (2) a group of two Thematic Apperception Test and two Michigan Picture Test pictures. The former was coded for extrapuniveness and the latter for aggressive content. Teachers rated the subjects for overt aggression. Subjects were ranked on all measures. Discrepancies between rankings in admitted aggression and rankings in projected and in behavioral aggression were used for analysis of the data.

The social interaction situations consisted of three tape-recorded dramas, one of which emphasized aggressive behavior on the part of the heroine with whom identification was fostered. Subjects were asked to describe the situation and answer true-false questions immediately after the presentation of each drama.

The first prediction postulated a positive relationship between admitted aggression and immediate-recall accuracy for the aggressive social situation. This was not confirmed by the data. The second prediction was that subjects whose projected aggression is greater than the aggression admitted to awareness would remember aggressive social situations less accurately than subjects

whose projection of aggression is more nearly congruent with admitted aggression. This prediction was partially confirmed when the Picture-Frustration Study was taken as the measure of projected aggression. It was not confirmed through use of the TAT and MPT pictures. The third prediction was that girls whose behavior is more aggressive than their self-descriptions would remember aggressive social situations less accurately than girls whose admission of aggression more nearly coincides with their actual behavior. There was a slight tendency towards confirmation of this prediction.

Four predictions relating intelligence and social class to the management of aggressive impulses were all largely confirmed. Middle-class (rather than lower-class) subjects and the more intelligent subjects tended to describe themselves as aggressive, and as having conflict between their aggressive impulses and their standards about aggression. In addition, they tended to be realistic about the extent of their own aggression. Although social class and intelligence were correlated to a small extent in this sample, their effects on the other variables were largely independent of one another.

Aggression in self-description, projective material, and behavior were generally unrelated to one another, with the exception of one low positive correlation between TAT and MPT aggressive content and teachers' ratings of behavior. Microfilm \$2.75; Xerox \$8.00. 171 pages.

**THE RELATIONSHIP BETWEEN
THE LEVELING-SHARPENING PRINCIPLE
OF COGNITIVE CONTROL AND
RETROACTIVE INHIBITION**

(Order No. Mic 61-2415)

T. Leon Nicks, Jr., Ph.D.
Boston University Graduate School, 1961

Major Professor: Murray L. Cohen

This study is an investigation of an hypothesized relationship between the leveling-sharpening principle of cognitive control and proneness to interference in memory. Differences in amount of retroactive inhibition for leveling and sharpening groups as a function of degree of meaningful similarity between original and interpolated learning is an additional concern of this investigation.

The concept of principles of cognitive control was proposed by Klein and his associates to account for consistencies in the manner that individuals organize stimuli in cognitive tasks. These consistencies are assumed to reflect the executive direction of the Ego control system.

Studies by Klein and Holzman related the leveling-sharpening dimension of cognitive control to assimilation-proneness in the time error situations investigated by Kohler and Lauenstein. The leveling extreme of this dimension is characterized by a tendency to de-differentiate the stimulus field by reducing figure-ground distinctions and assimilating new stimuli to an existing dominant organization. The sharpening extreme refers to an elaboration of the field by heightening figure-ground distinctions, exaggerating changes and exploiting stimuli differences. Theorizing on the basis of the Kohler-Lauenstein trace

explanation of time error to account for the greater assimilation-proneness of levelers, Holzman hypothesized that the leveling-sharpening dimension is associated with the strength and permeability of memory trace boundaries; the leveling extreme of the dimension reflects a condition of more permeable and weaker trace boundaries than the sharpening extreme. He predicted that leveling-sharpening is relevant to assimilation-proneness in retroactive inhibition and other situations in which firmness of stimuli boundaries can be varied.

Retroactive inhibition is explained by memory theorists as involving interaction between separate memory traces of between response tendencies. Osgood's theory of memory maintains that in a learning situation in which S units are held constant while R units are varied, retroactive inhibition increases as meaningful similarity between R units in IL and OL decreases.

Recent studies have demonstrated that while amount of retroactive inhibition is a function of strength and rate of learning, leveling-sharpening is not related significantly to these aspects of acquisition.

On the basis of Holzman's explanation of assimilation-proneness and Osgood's theory of memory, the following hypotheses were generated:

1. The amount of retroactive inhibition increases as the tendency towards leveling increases.
2. The increment in amount of retroactive inhibition as IL becomes less similar to OL increases as the tendency towards leveling increases.
3. There is no relationship between the leveling-sharpening dimension of cognitive control and learning ability.

Seventy-seven subjects were administered the predictor instrument for leveling-sharpening (Schematizing Test). Paired-associates learning lists containing nine items with consonants as S units and two syllable adjectives as Rs were used in the retroactive inhibition task. S units were identical in IL and OL lists, but Rs were varied. The IL list contained three adjectives that were highly similar, three that were moderately similar and three that were of low similarity to corresponding OL R units. Difference in average response latency on OL and relearning trials was used as an index of amount of retroactive inhibition. Number of trials to criterion on OL was used as a measure of rate of learning and average latency on the last trial of OL measured strength of acquitition.

The results of the study supported the first and third hypotheses. It was concluded that the occurrence of interference in memory is dependent upon the leveling-sharpening dimension of cognitive control which reflects an organizing principle governing the neural correlates of memory. Failure to confirm the second hypothesis was discussed in terms of unforeseen complications of the experimental design and an apparent inaccuracy of that portion of Osgood's transfer and retroaction surface pertaining to response similarity.

The relevance of the findings to the similarity paradox in learning and memory was discussed. Some implications for future research were outlined.

Microfilm \$2.75; Xerox \$5.40. 107 pages.

EXPRESSED SELF CONCEPT AND ADJUSTMENT IN SEXUALLY DELINQUENT AND NON-DELINQUENT ADOLESCENT GIRLS

(Order No. Mic 61-1582)

John Francis Purcell, Ph.D.
Fordham University, 1961

Mentor: Anne Anastasi, Ph.D.

The purpose of this investigation was to explore the hypothesis that attitudes of depreciation and lack of self-esteem characterize the self concept of the delinquent adolescent girl. The study involved a comparison of 100 delinquent and 100 control subjects on several measures providing various indices of the way in which an individual accepts and values herself. Delinquents and controls were matched on a group basis in age, race, and religion and were also similar in socioeconomic status, national background of parents, and language spoken in the home. Precautions were taken to insure that the two samples were distinctly different in the matter of delinquency. The instruments used were: Adaptation of the Brownfain Self Concept Scale; Thurstone Temperament Schedule; Modified Gough Adjective Check List; IPAT Anxiety Scale.

Results were organized for discussion into mean differences between delinquents and controls, intercorrelations among instruments, and an extreme groups comparison within delinquent and control groups. Delinquents and controls were compared on the Brownfain private, positive, negative, and social scales; the stability and social conflict indices; and the self-acceptance measure. On all but the stability index, the controls obtained significantly higher mean scores and showed less variability than the delinquents, indicating a higher self concept level in the former group. For the stability index, the mean difference lay in the direction opposite to that predicted. The delinquents showed less change in the self concept than the controls who thereby evidenced greater flexibility.

Correlations were obtained for 16 variables from the four instruments, a total of 120 for each of the two groups. Coefficients for the delinquents were generally higher than for the controls, a finding attributed to the greater heterogeneity in the delinquent distributions. The correlational hypothesis that low Thurstone (E) scores for the delinquents would be found in conjunction with wide limits on the stability index was not verified. Results indicated that those delinquents who changed their ratings more under given instructions were more emotionally stable. Regarding the correlational hypothesis that the more anxious the individual, the lower her self concept when following negative self concept instructions, results were significant and in the expected direction in both groups. Further correlational analysis comparing the private self concept and the stability index indicated that the former measure bears a higher relationship with other variables than the latter.

With scores on the private self concept measure as the criterion variable, a contrasted groups comparison was conducted within each sample, using the 27 subjects with the highest and 27 with the lowest scores. Results were generally consistent with intergroup differences and correlational findings. Wide limits to the stability index for delinquents with higher self concepts suggested that, in the case of adolescents, wide limits indicate better adjustment. Significantly higher Thurstone (E) scores for delinquents

with better self concepts were noteworthy because no significant differences had been found between delinquents and controls. For the IPAT Anxiety Scale and the Modified Gough Adjective Check List, findings were in accord with those obtained in the intergroup comparisons.

The data of the present investigation support the general hypothesis that delinquent girls manifest poorer self concepts than non-delinquent controls. Although generalizations beyond the criterion of sexual delinquency would be tenuous, the possibility exists that the self concept might assume the proportions of a unifying construct in regard to delinquency if future research should show unfavorable attitudes of self-reference to be associated with many kinds of delinquent activity.

Microfilm \$2.75; Xerox \$8.00. 174 pages.

SOME PERSONALITY TRAITS OF
JUVENILE DELINQUENTS AS INDICATED BY
A RATING TECHNIQUE UTILIZING
THE SYMONDS PICTURE STORY TEST

(Order No. 61-3588)

James Irwin Stickler, Ph.D.
Temple University, 1961

The Problem

In this study, an attempt has been made to investigate: (1) whether delinquents differ from nondelinquents with respect to hostility, rejection, guilt, anxiety, and egocentrism; also (2) whether groups of delinquents, classified according to crimes perpetrated, i.e., assault and battery, burglary, and sex crime, differ from each other with respect to the above traits; (3) whether delinquents differ from nondelinquents when separated into white and colored groups, with respect to hostility, rejection, guilt, anxiety, and egocentrism; and (4) whether racial differences exist with reference to the five traits.

Subjects

The subjects used in this study were 288 adolescents, selected from a large metropolitan city. All were males from 13 to 17 years of age, inclusive. The delinquents were detained for short periods at the Youth Study Center, Philadelphia, Pennsylvania. The nondelinquents were selected from high delinquency rate schools in the Philadelphia Public School System.

The delinquents were selected according to crime perpetrated, i.e., assault and battery, burglary, and sex. The nondelinquents were adolescents who had never gotten into difficulty with the law and/or school officials.

Methods and Procedures

A somewhat unique picture story technique was constructed so that the response of the subject would indicate a specific trait. Five personality traits (hostility, rejection, anxiety, guilt, and egocentrism) were measured by means of having the subjects rate stories whose content

exhibited one of the above traits, on a four point scale, as to how well the story "fits" the Symonds pictures, Set B. The stories were originally obtained from delinquents and nondelinquents using the Symonds pictures as a stimulus. The sum of the ratings of a particular type of story content was the subject's score for that particular trait.

The Wonderlic Personnel Test and the Revised Chapman-Sims Socio-economic Scale were administered to the subjects. Then the picture story form was administered.

Results and Conclusions

In an area as complex as juvenile delinquency, conclusions must be made with extreme caution. However, on the basis of the results obtained in this research, and subject to the limitations prescribed, the following inferences may be drawn:

1. The white delinquents, as a group, exhibited greater feelings of anxiety and of guilt than the white nondelinquents. There were no significant differences with respect to hostility, rejection, and egocentrism. The same relationships were found between the colored delinquents, as a group, and the colored nondelinquents.

2. When adjustments were made for socio-economic status, the white and colored groups, taken together, but classified into sub-groups on the basis of type of offense, i.e., assault and battery, burglary, and sex, the following relationships were found:

- (1) Both burglary and sex crime groups exhibited greater rejection than the assault and battery group.
- (2) All crime groups exhibited greater feelings of anxiety and of guilt than the nondelinquents.
- (3) No differences with respect to hostility and egocentrism were obtained.

The same relationships were found when the adjustments were made on the basis of intelligence scores.

3. When adjustments were made for socio-economic status and for intelligence test scores separately, no racial differences were found with regard to hostility, rejection, anxiety, guilt, and egocentrism when races were treated as a whole nor sub-divided into crime groups.

4. Comparisons among the white sub-groups (the three crime groups and controls) revealed the following significant relationships:

- (1) The sex crime group displayed greater hostility than the nondelinquents.
- (2) The sex crime group displayed greater hostility than the assault and battery group.
- (3) The burglary and sex crime groups showed greater feelings of anxiety and of guilt than the nondelinquents.

All other comparisons among the white sub-groups showed no significant differences.

5. Comparisons among the colored sub-groups (the three crime groups and the controls) revealed the following significant relationships:

- (1) The assault and battery, burglary, and sex crime groups were each found to have greater feelings of anxiety than the nondelinquents.
- (2) The assault and battery and the burglary groups each showed greater guilt feelings than the nondelinquents.

All other comparisons among the colored sub-groups showed no significant differences.

Microfilm \$2.75; Xerox \$8.40. 183 pages.

STIMULUS GENERALIZATION IN RELATION TO STRESS AND DEFENSE

(Order No. Mic 61-1101)

Stanley Harold Teitelbaum, Ph.D.
Boston University Graduate School, 1961

Major Professor: Chester C. Bennett

The purpose of this experiment was to investigate the relationship between stimulus generalization and the variables of stress and defense style. Accordingly, performance on an auditory stimulus generalization task under no-stress and stress conditions was studied among a group of college students. Half of the group was composed of subjects who were classified as repressors while the other half consisted of subjects classified as intellectualizers. Predictions were generated from research related to a) the relationship between stress induced by a noxious stimulus and performance on stimulus generalization tasks and b) the effectiveness of defense styles in the management of anxiety aroused by a stressful situation.

Hullian theory maintains that an individual's performance on conditioning and learning tasks can be ascertained from a knowledge of the level of excitatory potential operating in a given situation. The construct excitatory potential presupposes a multiplicative relationship between habit strength and total effective drive level. This relationship is expressed by the formula $sEr = f(sHr \times D)$. Spence, Taylor and their associates have elaborated a "drive theory" from Hull's system and have investigated the effects of anxiety, as a drive, in a variety of conditioning and learning experimental situations.

Stimulus generalization has been referred to, in Hullian terms, as a spread of habit strength from the conditioned stimulus to other stimuli. Studies by Rosenbaum and Mednick have demonstrated that high drive level tends to produce elevated generalization responsivity.

In recent years several research studies have emerged which emphasize the importance of the effectiveness of defense mechanisms in the management of anxiety aroused by stressful experimental conditions. It is maintained that performance in conditioning and learning situations can in large measure be influenced by the disruptive effects of anxiety. Hence, the consideration of the adequacy of defense style in dealing with experimentally aroused anxiety is considered to be a particularly meaningful area of re-

search. It is further suggested that effectiveness of defense style is related to the specific experimental conditions to be employed. The rationale employed in the present study was that intellectualizing defenses are more suited to deal with the stress engendered by the presence of shock utilized in this experiment than repressive defenses.

It was therefore assumed that both drive level and the adequacy of defenses in managing the anxiety aroused by the experimental situation are determinants of an individual's performance on a stimulus generalization task.

On the basis of these assumptions the following predictions were generated:

1. In the presence of induced stress individuals will perform with an increase in responsivity to generalized auditory stimuli as compared to their performance under no stress conditions.
2. As a function of induced stress individuals employing a repressive defense style will show a relatively greater increase in responsivity to generalized auditory stimuli than individuals employing an intellectualizing defense style.

Forty-eight Ss who obtained extreme scores on the hysteria-psychasthenia scale of the MMPI were selected from among a large group of college students. An auditory stimulus generalization task patterned after that used by Garnezy was utilized. There were two experimental conditions, each of which included a standard and four generalized tones, which were varied along the dimension of frequency. After receiving training in which they pulled a lever following each presentation of the standard tone, Ss were given ten trials to each of the five stimuli. The frequency of pull responses to the generalized tones was used as the measure of stimulus generalization. The stress condition differed from the no stress condition in that it included the presence of five strong electric shocks which were administered to the subject's wrist during the test series.

The results of the study supported the first prediction. It was concluded in accordance with drive theory that experimentally induced stress operated as a relevant drive in elevating response gradients of generalization.

Results contrary to prediction were obtained with regard to the second prediction. These findings were discussed in terms of the influence of irrelevant drive level and the adaptiveness of intellectualizing and repressive defenses to the stress conditions employed. Some implications for future research were outlined.

Microfilm \$2.75; Xerox \$6.80. 145 pages.

RELATIONSHIPS AMONG
THREE MEASURED LEVELS OF
PERSONALITY FUNCTIONING:
SELF-ASSESSMENT, FANTASY, COPING ACTIVITY
AND THEIR RELATIONSHIPS TO RATINGS
OF REAL-LIFE BEHAVIOR.

(Order No. Mic 61-1275)

Gordon Gilbert Wilson, Ph.D.
University of Denver, 1960

The purpose of this study has been to investigate the interrelationships among three of the standardly measured levels of personality need manifestation, and the relationship of each to real-life behavior. Achievement, exhibitionism, aggression, and abasement need strengths were assessed with the Personal Preference Schedule (PPS), Apperceptive-Fantasy Test (AFT), and Miniature Situations Test (MST), respectively representing the levels of self-assessing, fantasy, and coping behavior. The PPS is a standard self-report procedure. The AFT, developed specifically for this study, employs pictorial stimuli selected from standard apperceptive-type tests. The MST is a recently developed procedure assessing coping responses to people or objects in miniature situations. Each test employs the forced choice principle to measure ipsatively personality need manifestation as reflected by statements (PPS), stories (AFT), and instrumental act tasks (MST).

The tests were administered to delinquent adolescent inmates confined at a Federal Correctional Institution. The test measures of the need strengths of 36 inmates evidencing a good institutional adjustment and 36 inmates making a poor institutional adjustment were intercorrelated with estimations of need strength expressed in real-life behavior. The latter were obtained by pooling three independent adjective check list ratings made by parole, dormitory, and work detail officers. These inmate groups are housed separately primarily on the basis of previous overt behavior. It was assumed that behavioral differences between subject groups would be reflected in test-measured and behavior-rated need strength expression. Therefore, behavioral ratings were expected to be significantly different for the two groups. Further, it was hypothesized that the magnitude of correlations between the various need strengths expressed at different test levels and behavioral ratings of need strengths would be of approximately the same order. Although the results supported these predictions, their importance is attenuated since other hypotheses were not confirmed.

It was hypothesized that significant relationships among the test level measures of the strength of personality needs would be demonstrated, and that the closeness of correspondence to need strengths expressed in behavior would be reflected by test levels in the following hierarchical order: coping level, fantasy level, and self-assessing level. Significant relationships between test and behavioral levels were generally not indicated. There was a tendency for correlational values to approach significance, particularly in the case of the poorly adjusting subjects. A tendency toward the postulated hierarchical order was also observed, but only for this group, and only in relation to the average correlational values obtained from the simultaneous consideration of all needs at each level. The order was not consistent across levels for any single need. None

of the average correlation values approached an acceptable level of significance.

The hypothesis that the group of poorly adjusting subjects would evidence greater variability of test scores was not supported. The raters judged the behavior of this group as showing a significantly greater strength of aggressive and exhibitionistic needs, and a significantly lower strength of achievement and abasement needs than did the adequately adjusting subjects. Significant differences between the groups in aggression need strength were reflected by each of the tests; however, the tests did not reflect other significant need strength differences between the groups, except for the PPS measure of abasement.

The validity of ratings may be questioned; however, the adequacy of these tests, particularly for this subject population, is more questionable. The MST, evidencing the closest relationship to rated real-life behavior appears to be a promising technique worthy of further refinement. The idea that predictive accuracy may be improved by relying on test responses most closely resembling behavior about which predictions are often made was lent some support in this study. However, the conclusion is reached that one-to-one relationships of personality attributes expressed at different levels of behavior should not be expected. Further investigation of the interrelationships among levels of behavior is suggested.

Microfilm \$2.75; Xerox \$8.60. 189 pages.

PSYCHOLOGY, EXPERIMENTAL

A BEHAVIORAL ANALYSIS OF
SOME VENTRAL AUDITORY PATHWAYS
IN THE MEDULLA OF THE RAT

(Order No. Mic 61-715)

Robert Miles Abelson, Ph.D.
Boston University Graduate School, 1961

Major Professor: Professor J. M. Harrison

Rats were trained on three schedules of reinforcement, a sound aversive schedule, a light aversive schedule and a sound and light discrimination schedule. On the aversive schedules a press response terminated the aversive stimulus. On the discrimination schedule a response in the presence of either stimulus produced food. An auditory threshold was measured on this schedule. Following training the animals received electrolytic lesions in the ventral auditory system of the medulla. Following this they were tested on the behavioral schedules. The brain of each animal was then removed and impregnated with protargol for microscopic examination. Six rats received unilateral lesions, seven received bilateral lesions and six received sham operations.

The results were as follows. Of the six animals who received unilateral lesions, one showed a substantial loss of the sound aversive behavior. Of the seven who received bilateral lesions five suffered a loss of the aversive behavior. Of these five, two had a substantial increase in the discriminative threshold. The behavior of the

animals who received sham operations was essentially unaffected.

There was a consistent relation between extensive damage to the large fiber pathway, the superior olivary pathway and the small fiber pathway and loss of the auditory aversive behavior. Destruction of the superior olivary pathway was not sufficient to produce a loss of the aversive behavior. The suggestion in the literature that the large fiber pathway is responsible for the maintenance of the aversive behavior was confirmed. Destruction of the superior olivary pathway either alone or in combination with destruction of the large fiber pathway did not materially change the auditory discriminative threshold. Destruction of all ventral acoustic pathways caused a loss of both aversive and discriminative auditory behaviors. Dorsal auditory pathways did not by themselves support either behavior. It has not been possible to determine if destruction of the small fiber pathway by itself can cause a loss of discriminative behavior. It was not possible to determine if return of the release response was due to the lesion or due to the loss of the press response.

Microfilm \$2.75; Xerox \$3.00. 59 pages.

TELEVISION ANALYSIS OF THE BEHAVIORAL ASPECTS OF TOOL-USING

(Order No. 61-3086)

Orlando Charles Behling, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Karl U. Smith

The two experiments reported in this thesis were performed to determine the effects of changing the source of visual feedback cues from normal hand-trace feedback to hand only and trace only feedback and of changing the orientation of the visual field on performance durations and quality of handwriting, a simple tool-using task.

In hand-trace feedback, the subject saw both his hand performing the movements and the graphite trace of those movements. In hand only feedback, he saw his hand but not the graphite trace. In trace only feedback, the subject saw a representation of the graphite trace but not his hand. The three feedback conditions were provided by a special writing board and a closed-circuit television system which was the subject's only source of visual cues.

The orientations of the visual field were also controlled by the television system. By means of special switching circuits, the visual field could be electronically inverted, reversed, or inverted and reversed.

Performance was measured in terms of speed and quality of writing. On neither of these measures did significant effects of the feedback conditions appear. Performance varied significantly for the orientations of the visual field on both measures, however. Performance was poorest with inversion, followed in order by inversion and reversal, reversal, and normal orientations. Significant differences were also found related to the nature of the movement pattern. Diagonal movements took longer to perform than did axial ones. More complex movements were affected to a greater extent than were simple ones.

The implications of these results for seven different

types of theories of perceptual-motor integration were discussed. Some of these theories were atomistic in nature. That is, they considered complex movements to be no more than the sum of simple ones. These theories were considered to be inadequate to explain tool-using behavior, since they made no allowance for the demonstrated interdependence of component movements in complex tasks. Other theories were classified as interactive. For the most part, such theories were incapable of explaining the differential effects of the changed orientations of the visual field. The most important criticism made of both types of theories was that they were unable to explain the nature of visual feedback in the use of tools. All of these theories, with the exception of the neurogeometric theory of motion, considered feedback control in terms of individual finger and hand movements, rather than in terms of the movements of the hand-tool unit. The results of these studies indicated that the latter was taking place in these experiments.

Microfilm \$2.75; Xerox \$5.40. 106 pages.

SERIAL LEARNING: AN APPROACH TO A RATIONALE FOR AUDITORY TRAINING

(Order No. 61-2919)

Frederick Sven Berg, Ph.D.
Southern Illinois University, 1960

Supervisor: Dr. Chester J. Atkinson

The acquisition of native language is the key to the habilitation of the deaf. In its connected form, speech or spoken language is characterized in part as a series of trains of syllables. Consequently, one of the tasks of speech acquisition is the serial learning of these trains.

The present study proposed that the deaf could use residual hearing to learn serially material resembling some aspects of spoken language. The anticipation learning technique was used. The material consisted of trains of pure tone pulses, 1000, 2000, and 3000 cps in frequency, occurring at rates of three, four, and five times per second, that could be identified as the digits one through five. The equipment for the preparation and presentation of the pulses included generating, recording, editing, dubbing, and playback devices. According to analysis of variance, no significant differences existed between a small sample of deaf and non-deaf undergraduate college students who served as subjects. Use of the same analysis revealed that the frequencies, durations, and frequency-duration interactions of the pure tone pulses did not affect the serial learning of nine auditory tasks. Comparisons were made between the deaf and the non-deaf as to trials to learn, number of errors, the acquisition process, and the serial position effect. The group curves describing the acquisition process or the serial position effect were similar and classical in form. As determined by trials and errors, the major conclusions were: (1) the young deaf adult did not seem to be handicapped in the serial learning of identifiable auditory material, (2) a measure of serial learning might be used, along with other similar measures, to contribute to the establishment of an objective and differential

rationale for auditory training, and (3) education of the deaf is challenged to use the auditory sense for the development of spoken language proficiency. A related conclusion was that the serial anticipation method and trains of tone pulses might have application in speech and hearing programs, for diagnosis, prognosis, and training procedures. Microfilm \$2.75; Xerox \$4.80. 95 pages.

THE NEGATIVE AFTER-EFFECT
OF MOTION AS A FUNCTION
OF TEST STIMULUS TEXTURE

(Order No. Mic 61-2414)

Michael Arthur Cann, Ph.D.
Boston University Graduate School, 1961

Major Professor: Murray L. Cohen

The purpose of this study was to investigate the relationship between the texture of the test stimulus and the rate of the negative after-effect. The viewing of a rotating spiral inspection stimulus gives rise to a negative after-effect of motion. This after-effect is viewed on a stationary test stimulus surface. A theory based on contour phenomena was proposed to account for the texture effects.

The recent literature has consisted mainly of studies which attempt to use the negative after-effect to diagnose brain damage. These studies have produced equivocal results. Several early investigators pointed to the texture of the test stimulus as a significant variable of the negative after-effect. However these suggestions were not followed up. Instead primary concern has been given to the parameters of the inspection stimulus.

Explanations of the negative after-effect have invoked both peripheral and central mechanisms. Recently attempts have been made to extend satiation theory of figural after-effects, and its derivative, statistical summation theory, to explain the negative after-effect.

The theory on which the present study is based assumes that there will be an interaction in the observer's visual cortex between the after-excitation which persists after the inspection stimulation ceases, and the second excitation which arises from the test stimulus. In the case of fine textured test stimuli, the close spacing of cortical contour correlates is assumed to result in high mutual inhibition and low stability of cortical correlates. This is assumed to result in low resistance to spread of after-excitation, and a high rate of after-effect. In the case of coarse textured test stimuli the opposite conditions are assumed to prevail, resulting in a low rate of after-effect.

A population of responses was sampled from six college students. Six textured test stimuli were used, from coarse to fine. These were presented in random sequence each day for five days, with three replications on each day. Each trial consisted of a 30 second period of inspection of the rotating spiral stimulus, followed by the observation of the after-effect on the textured test stimulus. This was followed by a 30 second rest.

The hypothesis tested was as follows: the perceived rate of the after-effect is a function of the coarseness of the test stimulus. As coarseness increases, rate decreases.

Measures of rate were taken for each subject. A three classification analysis of variance was applied to the data. The hypothesis was supported by the data from all subjects.

Several additional findings were made. Measures of total displacement (magnitude) of the effect were taken and it was found that the magnitude of the effect also varied as a function of coarseness of the test stimulus. As coarseness increased, magnitude decreased. A second unanticipated finding was a significant effect over days for both rate and magnitude. This was systematic however, only in the case of one subject.

For all subjects, the relationship between coarseness of texture and rate of the effect can be expressed by a positively accelerated function expressed by the formula $x = y^n + k$. The same relationship holds between coarseness of texture and magnitude of the effect.

The subjects showed considerable individual differences in both rate and magnitude of the effect.

The strength of the texture effects indicates that this dimension should be considered in future studies of the negative after-effect.

Microfilm \$2.75; Xerox \$7.80. 169 pages.

DISCRIMINATION WITHOUT AWARENESS
IN A PSYCHOPHYSICAL TASK

(Order No. Mic 61-711)

Preston Davis, Jr., Ph.D.
Boston University Graduate School, 1961

Major Professor: Professor Austin W. Berkeley

Discrimination without awareness of the stimuli being responded to has been observed in a number of different experimental situations. In the classic case, the subject is instructed to relax or to engage in what is essentially a task of imagination, while incidental stimulation is presented at a level of intensity or duration such that he remains unaware of its presence. Responses of some comparatively unrestricted type are collected and analyzed for effects attributable to the stimulation.

Present interest is in the case where the subject is effortfully attending to an objective task of discrimination. His range of possible responses to the task is quite narrow, and he is required to respond almost at once. The incidentally supplied stimulation is of a novel class, different from the stimulus material of the attended task; it is such as to present directly one of the possible task responses.

The method used was an adaptation of a psychophysical judgment procedure, with individual subjects viewing the materials in a tachistoscope. A rectangular patch of standard size was presented first, followed in a few seconds by a test patch of variable size; the subject was required to report whether the latter was greater or smaller than the standard. A brief, unnoticed flash preceding the test patch carried the word greater or smaller or a nonsense control stimulus.

A first experiment, using only three subjects, failed to yield any evidence of influence upon the judgments due to the unnoticed incidental words.

In the second experiment, 32 subjects participated. The duration of the incidental flash was gradually increased

until the subject reported noticing its presence. Statistical analysis was restricted to the last 40 responses obtained at duration levels lower than the level at which recognition occurred.

For the test patch of the same size as the standard (which had been presented on 24 of the 40 trials), it was clear that some subjects had indeed been influenced in the direction of agreeing with the unnoticed greater or smaller. The effect was statistically significant over all 32 subjects. About ten achieved a high degree of agreement with the incidental word, while the agreement scores of the others were distributed in approximately a chance fashion. Agreement was not influenced by sex of the subject.

Four other test patches were of sizes greater or smaller than the standard. For two of these patches, subjects responded more accurately following the appropriate flash of greater or smaller than following the nonsense flash.

No consistent relationships were found between latency of responding and agreement with the flashed stimulus.

It is concluded from the main result that attended judgments of objective matters are (among some individuals) subject to influence from unreportable stimulation which directly presents the response to be used. This implies some necessary modification or extension of remarks made by Klein and others relative to this point. While attention usually acts to exclude activations which would be consciously rejected as inappropriate, such activations do (among some individuals) in a significant number of cases influence attended behavior without becoming conscious.

A tentative conceptualization of the process is presented, based on psychoanalytic considerations by Kris and Fisher. Microfilm \$2.75; Xerox \$6.40. 135 pages.

THE EFFECT ON CRITICAL FUSION FREQUENCY OF HOMOCHROMATIC AND HETEROCHROMATIC STIMULUS ALTERNATION

(Order No. 61-3100)

Leonard Albert Evans, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Frederick A. Mote

A distinction is made between homochromatic intensive functions, e.g., $\Delta I/I$, dark adaptation, etc. and heterochromatic intensive functions, e.g., two-color threshold, chromatic adaptation preceding the intensive function, etc. The thesis was that wavelength differences affect the integration of luminances. As a test of this thesis the alternation of illuminations differing in wavelength upon CFF was investigated.

Three subjects were used, each having normal color vision. The apparatus presented to the subject a $2.4^\circ \times 1.2^\circ$, foveally fixated test patch which could be alternately illuminated from two optical paths through a clear section in a sector disc. A 12° white surround was centered about the test patch. The speed of the disc, the luminance of the comparison path and the luminance of the surround could all be controlled by the subject. The illumination transmitted by an interference filter with a peak transmittance

at 449 millimicrons served as the standard luminance. The illumination transmitted by four other interference filters -- 448, 522, 583 and 671 millimicrons -- could be presented to the subject alternately with the blue standard. All of the filters were equated in luminance to the blue standard by flicker photometry and direct comparison.

Two flicker methods for determining CFF's were used. One, heterochromatic flicker, consisted of presenting to the subject the blue standard alternately with another blue color as well as a green, a yellow and a red color. A complete cycle of the sector disc presented the following sequence, with equal duration of the components of the "double cycle": light from the standard, no light, light from the comparison, and no light. The subject adjusted flash rate until CFF was obtained when the comparison luminance was set equal to, above and below the photometrically determined equality setting between that particular comparison color and the standard. The number of flashes per second required to reach CFF, at each comparison luminance setting was recorded. The other, standard flicker, consisted of presenting alternately each color with itself set at the equal luminance setting used for heterochromatic flicker. The subjects adjusted flash rate until CFF was reached and the number of flashes per second at CFF was recorded.

The major findings were these:

1. There was a significant difference among the heterochromatic treatments. When tested by the "t" test every heterochromatic treatment was significantly different from the blue-blue treatment, which was regarded as a standard flicker determined threshold.
2. For all three subjects there was a significant difference between the mean CFF's obtained using standard flicker for the yellow comparison stimulus compared to the mean minimum CFF's obtained using heterochromatic flicker. Two subjects showed a significant difference between standard and heterochromatic for red and only one subject showed a significant difference for green.

Microfilm \$2.75; Xerox \$3.00. 47 pages.

THE EFFECTS OF VARIATIONS OF RHYTHMICAL COMPONENTS UPON THE ACCURACY OF SYNCHRONIZATION

(Order No. 61-2997)

Carroll Fredric MacDorman, Ph.D.
University of Arizona, 1961

Supervisors: Neil R. Bartlett
Salvatore V. Zagana

The purpose of this experiment is (1) to explore the facts concerning the accuracy with which a group of subjects can synchronize with repetitive models of auditory stimuli, varying in the complexity of the arrangement of their sound-silence durations, and (2) to study the relationship between accuracy of synchronization and the rate of presentation of the models. An especially constructed

interval timer controlled with precision the sound-silence durations and the speed of presentation of the auditory models. Polygraph recordings were made simultaneously of the models and the subjects' synchronizing responses on a telegraph key. Extensive research of the literature revealed no studies in which the ability of subjects to synchronize with models of varying sound-silence durations was investigated.

Four models were constructed in which intensity, frequency, and meter were held constant, while the form (and, therefore, the complexity) of the sound-silence durations increased progressively from Model 1 to Model 4. These models were presented at the rates of 1.0 sec., 2.0 secs., 3.0 secs., and 4.0 secs. The eight male, paid volunteer, undergraduate students at the University of Arizona received ten days of training in synchronizing with both the onset and duration of each of the 16 model-rate combinations for 60 seconds daily prior to the final run.

Two series of reaction time tests were administered. A negative correlation was found between accuracy of synchronization and reaction time. The average synchronization errors for all model-rate combinations were significantly less than reaction time except for Model 4, Rate 4.0 secs. Here three subjects made synchronization errors greater than their reaction time. Their upper limit of synchronization for Model 4 is at or before 2.4 secs., the duration of the model's silence interval. Improvement in synchronization continued up to the last day, indicating that most subjects had not yet reached their optimum performance. Synchronization with onset of the sound improved before synchronization with duration, and on the last day was far more accurate for three-model-rate combinations. Seventy per cent of the onset error was anticipation. Both onset and duration drift occurred frequently until the last days of the experiment when synchronization became more accurate.

Four factors are related to difference in accuracy of synchronization: (1) length of the sound intervals, (2) length of the silence durations, (3) the rate of presentation of the models, and (4) model complexity. An analysis of variance showed that subjects, rates, and model-rate combinations made contributions at better than the one per cent level, while models contributed at better than the five per cent level. The Tukey Gap Test revealed a significant gap between the four models presented at Rate 1.0 sec. and the other 12 model-rate combinations. The rate 1.0 sec. models averaged twice the magnitude of error and twice the scatter. There was little difference between the average errors at the other three rates.

The average of the Model 1 scores showed the most accuracy. Models 2 and 3 were almost equal, and Model 4 was least accurate. The equality of Models 2 and 3 is probably related to the fact that Model 2 has longer silence intervals. There appears to be a relationship between model complexity and synchronization.

The influence of the silence interval varies from one model-rate presentation to the next, indicating that subjects responded to the models as rhythmic units. At Rate 1.0 sec. a comparatively long silence interval aids accuracy, while, at Rates 3.0 secs. and 4.0 secs. it impedes accuracy. In Model 4 the difference between the 1/10 and 6/10 silence intervals begins to exert an influence between 1.2 and 1.8 secs. It is suggested that here a breakdown in rhythm begins. The influence of the length of the sound durations, as studied in Models 3 and 4 is comparatively slight. Microfilm \$2.75; Xerox \$7.80. 168 pages.

THE EFFECTS OF FORNIX LESIONS ON EMOTIONAL AND TIMING BEHAVIOR IN THE RHESUS MONKEY

(Order No. 61-3271)

Bernard Martin Migler, Ph.D.
University of Pittsburgh, 1961

Supervisor: R. A. Patton

The experiment was designed to investigate the behavioral effects of sectioning the fornix, a major conduction pathway of the rhinencephalon. The role of the rhinencephalon in emotional behavior has received much support in recent years, and additional data specifically on the role of the fornix were desired. This led to the selection of the "Conditioned Emotional Response" as the first test of the behavioral effects of fornix lesions.

Very few data are available concerning the central mechanisms mediating timing behavior. The possibility that parts of the rhinencephalon, perhaps the hippocampal-fornix system, participate in this function led to the selection of the technique of the "differential reinforcement of low rates" as the second test of the behavioral effects of the fornix lesions.

Six rhesus monkeys were trained to press a lever to obtain food on a variable interval reinforcement schedule. Each animal worked a three hour session every day. At varying intervals during the session a visual stimulus was presented for three minutes; at the end of this time a brief unavoidable electric shock was delivered and the stimulus lights turned off. This procedure produced a conditioned emotional response (acceleration and/or suppression during the stimulus). Three monkeys were then selected and bilateral fornix sections attempted. The histological results showed that two cases received complete bilateral lesions, and in the third case about ten per cent of the fornix fibers remained intact on one side. After an adequate recovery period twenty-five additional training sessions were given to all six monkeys. A small effect of the lesion was found in the form of a temporary decrement of the C.E.R. in the two bilateral fornix monkeys. However, since all fornix transected monkeys eventually demonstrated marked suppression, the writer rejected the hypothesis that response suppression during the pre-shock stimulus is mediated by inhibitory effects of the hippocampus acting through the fornix.

Ten sessions of extinction of the C.E.R. followed, in which the only change in procedure was the elimination of shock at the end of the visual stimulus. This yielded data which could not be easily interpreted. One bilateral fornix monkey showed the most resistance to extinction of all subjects in the experiment, and the second bilateral fornix monkey showed the least resistance to extinction. All other animals demonstrated intermediate rates of extinction.

Following the ten days of extinction the six subjects were trained on a "timing" procedure (D.R.L.) in which bar presses were reinforced only if they occurred twenty seconds or more after the previous bar press. No evidence of the involvement of the fornix in this type of timing behavior was found. The three animals with fornix lesions performed as well as or better than the unoperated controls.

The merits and liabilities of the brain lesion technique and the interpretation of behavioral deficits following central nervous systems variables were discussed.

Microfilm \$2.75; Xerox \$3.60. 64 pages.

THE DEVELOPMENT OF REFERENCE SYSTEMS IN CHILDREN

(Order No. 61-2998)

Jeanne Louise Rivoire, Ph.D.
University of Arizona, 1961

Supervisor: Dorothy I. Marquart

This is a study of the ontogenetic development of spatial concepts in children from four through fourteen years of age. It is an attempt to determine whether or not the development of the concept of space in children evolves in the sequence hypothesized by Piaget. He has reported that children of four or five years of age view objects primarily by topological relations. From the age of six on Euclidean and projective spatial relations develop until at the age of fifteen the development of the perception of objects is complete.

A total of 144 subjects of average ability as determined by the short form of the Stanford-Binet Intelligence Scale was used in this study. They represented the even year age groups from four years zero months to fourteen years eleven months. Each group consisted of twenty-four children evenly divided between boys and girls. The children all came from approximately the same middle class, socioeconomic background. They did not have severe emotional problems, physical handicaps, nor extreme reading problems.

A Form Development Test consisting of twenty-eight items devised by the author and designed to measure representational space was administered individually to each of the subjects employed. This test consists of seven items measuring predominantly topological space; seven items which measure predominantly projective space; seven items with affine characteristics; and seven items representing predominantly Euclidean characteristics. All items were checked by an expert in geometry in order to be relatively certain that each item would measure the desired space type. The geometer also checked to make sure that in each type of space there were easy and hard items so that children would not see all hard items measuring one type of space and all easy items for another type of space. Most of the items were two dimensional figures, three had three dimensional stimuli with responses in two dimensions. Two items were entirely three-dimensional. A standardized procedure was used to administer the test to the children.

Immediately following the administration of the Form Development Test, the children were presented with the extrovert-introvert scales of the ESPQ, CPQ, and HSPQ personality questionnaires as devised by Cattell and his co-workers. This was done in order to determine if a relation exists between the extrovert-introvert dimension of personality and spatial development in the child.

The tabulation results of this investigation show that most of the children in this investigation did not develop concepts of topological space before six years of age. Piaget reports that his four year old children had almost completed the development of these concepts. The children employed in this study developed projective spatial concepts earlier than the children reported by Piaget. The concepts involved in affine relations were well es-

tablished by the six year olds in the present investigation. This is much earlier than for the children reported by Piaget. The development of Euclidean concepts occurred later and with greater variability than reported by Piaget.

The statistical results show a significant difference between types of space, between items within each type of space, and between age levels. There is no significant differences between boys and girls. Pearson Product-Moment Correlations obtained from the Extrovert-Introvert Scales of the ESPQ, CPQ, and HSPQ and the Form Development Test are not significant.

On the basis of the findings of this experiment, the following conclusions were drawn: (1) in general, the occurrence of the specific stages in the development of the concept of space hypothesized by Piaget is not completely supported by the results of this study; (2) the type of space being viewed is important; (3) age is a significantly contributing factor in the development of the concept of space; (4) the individual item within the particular type of space being viewed is important in this development; (5) the development of perceptual processes utilized in seeing the visual world can not be actually studied by utilization of isolated geometric figures; (6) most children do not complete their space development by fifteen years of age; and (7) four year old children do not, as a group, conceive of space entirely as characterized by topological relationships.

Microfilm \$2.75; Xerox \$6.40. 132 pages.

THE DEVELOPMENT OF SOCIAL BEHAVIOR IN THE RHESUS MONKEY

(Order No. 61-3158)

Leonard Allen Rosenblum, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Harry F. Harlow

Eight rhesus monkeys were separated from their mothers 6-12 hrs. after birth and raised in individual cages with artificial mother surrogates. Once daily throughout the first six months of life the subjects were observed in an unrestricted social situation called the playroom, in two separate groups of four each containing two males and two females. Using check-sheet procedures, two observers scored the behavior of the members of each group of four in terms of a broad range of behavior categories covering early neonatal responses, social play responses, sexual behavior, aggressive behaviors, dominance development and nonsocial, environmentally-oriented play behaviors. In addition to indications of the frequency of these behaviors in each animal, the recipients and initiators of social interactions were tabulated. Analysis of the observations made during the first 6 months of life revealed the following facets of social behavior development:

1. During the first month of life the subjects showed initial socialization tendencies, including social explorations

involving visual, oral and manual channels; responses toward one another which resulted in group aggregation; and, marked responsiveness to the artificial surrogates present in the room. Similar responses also were directed toward nonsocial objects during this period.

2. These earliest reactions, termed preplay responses, seemed to underlie the later, more complex social patterns, comprising what has been called the "social play stage" of development. This latter stage was primarily characterized by play activities involving social partners and environmental stimuli. The three basic play patterns observed which showed a significant growth during the period studied were: a) Rough-and-Tumble Play which involved vigorous physical contact between partners; b) Approach-Withdrawal Play in which no contact was made between partners during chasing and follow-the-leader activities; and, c) Activity Play, a nonsocial play pattern which involved the exercise of developing dexterity and strength through jumping, swinging and running about.

3. During the course of the social play stage several behaviors developed differently in the males and females of the two groups. Threat responses and Rough-and-Tumble play behaviors appeared with significantly greater frequency in the males than in the females. On the other hand, rigidity, a pattern similar to "freezing," withdrawal responses and attentiveness to the artificial surrogates appeared with greater frequency in the females.

4. Sexual behavior itself did not appear to any great extent nor with any appreciable degree of maturity in either the males or the females. Nonetheless, there was a significant increase in immature sexual behavior during testing, and the orientation of mounting patterns in the males also showed significant improvement.

5. In both groups, patterns of dominance or group leadership in behavior developed after the first two months of life. In each group the males attained the most dominant positions as indicated by a dominance index composed of several standard behavior categories. It was pointed out, however, that the data for dominance and those for sexual differences *per se*, were confounded in the present study and that until groups can be obtained in which the dominance patterns between males and females are reversed no definite conclusions on sexual differentiation can be drawn.

Social behavior development observed in this study was similar to that described by previous authors for species both above and below the rhesus monkey on the phyletic scale. The fact that the behavior of our subjects was quite similar to behaviors observed both in the wild and in other laboratory situations implies that the basic forms of development which characterized our subjects probably hold considerable generality to the species as a whole.

Microfilm \$2.75; Xerox \$6.40. 134 pages.

THE EFFECT OF VARYING ACQUISITION TRIALS AND EXTINCTION TRIALS ON THE RELEARNING OF A MAZE HABIT

(Order No. Mic 61-2569)

Phillip Gerald Siegal, Ph.D.
New York University, 1961

Chairman: Dr. John J. Sullivan

A. The Problem

Does extinction result from counterconditioning or adaptation?

Sub-Problem I

A. What is the effect on the relearning of a maze of increasing the number of extinction trials?

B. What is the effect on the strength of a maze running habit as the number of learning trials are increased on a somewhat similar maze?

It would be predicted from Hull's reactive inhibition theory that the group which had the greatest number of extinction trials should show the greatest response time. Tolman and Spence would predict that the group with the greatest amount of trials, non-rewarded or rewarded, would show the smallest response time.

Sub-Problem II

What is the effect on the amount of spontaneous recovery of increasing the number of reinforced trials that are given prior to the extinction trials, the intertrial interval of the rewarded and non-rewarded trials being constant and spaced? Hull's position is that spontaneous recovery is dependent on the dissipation of reactive inhibition as a function of time. Liberman states that spontaneous recovery results from interference of inhibition during the intertrial interval. He contends that extinction generalizes to a greater degree than acquisition learning and is therefore more susceptible to interference. As generalization of extinction is restricted, other things constant, the amount of spontaneous recovery will decrease. Generalization of extinction can be restricted by a discrimination learning procedure. Liberman would agree that as the number of trials increase, the amount of spontaneous recovery decreases.

Sub-Problem III

A. Does a significant amount of spontaneous decrement occur between each set of trials (1) when a maze is being learned, (2) subsequent to the learning of an initial maze as a somewhat similar maze is being learned, and (3) during the relearning of a maze which has been extinguished?

B. What is the effect on the amount of spontaneous

decrement that occurs as the number of acquisition trials on a somewhat similar maze is increased?

C. What is the effect on the amount of spontaneous decrement that occurs during reacquisition of the maze running habit as the number of extinction trials is increased?

This sub-problem is an additional test of Liberman's position that the response strength of the habit with the broader gradient is more susceptible to interference.

B. Procedure

The subjects, 48 rats, were given 30 reinforced trials in the right arm of a diamond shaped runway. They were then divided into two groups. The extinction group received varied amounts of extinction in the right arm of the runway, were run 30 reinforced trials in the left arm, and then were run 30 reinforced trials in the right arm of the runway. The acquisition group received varied amounts of additional acquisition trials in the left arm of the runway, 70 non-rewarded trials in the right arm of the runway, and then 30 acquisition trials in the right arm.

C. Findings

1. Increasing the number of extinction trials resulted in an increase in habit strength.

2. As the number of acquisition trials during a discrimination procedure increased, the amount of spontaneous recovery decreased.

3. A decrease in response strength occurred 24 hours after the last set of 10 trials (spontaneous decrement): (1) during the learning of a second maze which had antagonistic responses associated with it, and (2) during reacquisition trials of an extinguished habit. Spontaneous decrement decreased as the number of additional trials (extinction or acquisition) increased.

These results are in conformity with interference of (expectancies) cognitive events or change in incentive motivation interpretations of extinction and with Liberman's theory concerning spontaneous recovery.

Microfilm \$2.75; Xerox \$3.80. 68 pages.

HUMAN TIMING BEHAVIOR

(Order No. 61-3287)

Julian Ingersoll Taber, Ph.D.
University of Pittsburgh, 1961

Supervisor: Robert A. Patton

Timing behavior was defined as the occurrence of previously specified behavior coincident with a predictable point on the chronological scale and independent of external discriminative stimuli. The operation which produces relatively accurate timing behavior, prearrangement of ap-

propriate contingencies of reinforcement, was included as a necessary part of the definition. The contingencies which shape, control, and maintain accurate timing behavior in both operant and respondent paradigms were discussed in a review of the literature.

After analysis of the existing literature on timing behavior, schedules of reinforcement were divided into frequency schedules and topographical schedules. It was argued that the only topographical schedule which exemplifies timing behavior is the differential reinforcement of response duration, and then only when termination of the response and not simple continuation of the response is reinforced. The advantage seen in using a topographical schedule to study timing behavior was the opportunity to measure a response continuously during the timing of an interval. The continuous measurement of a timing response provided data on response duration, response amplitude, and amplitude changes.

A schedule of reinforcement having two temporal parameters, t_1 and Δt , was described. This schedule uses positive reinforcement to differentiate the duration of an operant within preselected tolerances. Reinforcement is contingent upon the continuance of a response through time t_1 , an interval which begins with the onset of the response, and upon its termination during time Δt , an interval which begins with the lapse of t_1 .

Three experimental studies of human timing behavior using a topographical schedule were described. In these experiments human subjects made repeated responses on an ergograph trigger in an operant conditioning situation where response duration was differentially and immediately reinforced by means of signal lights.

In the first experiment four subjects were trained, in different experimental sessions, on t_1 values of .50, 1.00, 2.00, and 4.00 seconds. For each t_1 value Δt was 1/10 of t_1 . The experiment was twice replicated on the same subjects. The relative variability of response duration and mean response amplitude were found to be inversely related to t_1 .

In the second experiment six subjects were trained with a Δt of 1.00 to 1.10 seconds. In repeated experimental sessions these subjects were run with a constant and with a randomly varied inter-response-interval to examine the effects of this variable. It was found that although mean response duration was unaffected by the different inter-response-interval conditions, variability of duration was higher when the inter-response-interval was randomly varied. Mean response amplitude and variability of response amplitude both tended to be higher when inter-response-interval was not a constant.

The third study investigated the stability of the differentiated timing response following removal of reinforcement and correction. Four groups of subjects were trained with a Δt of 1.00 to 1.15 seconds. The effect of environmental illumination on timing behavior was studied by training subjects in either a fully lighted or a darkened room and by testing for response stability under these two conditions. The four groups were based on the two conditions of illumination and the two experimental conditions of training and estimation after removal of feedback. Group differences in the stability of response duration approached, but did not attain, statistical significance. There were no significant differences between groups in terms of response amplitude.

In general the results of these studies lend credibility to the suggestion that short interval timing behavior is related to, if not dependent upon, sensory (kinesthetic) adaptation effects. The use of a topographical schedule of reinforcement applied to human subjects was shown to be a reliable device for the study of relatively precise timing behavior. Microfilm \$2.75; Xerox \$7.40. 157 pages.

EXTINCTION FOLLOWING
QUALITATIVE CHANGE IN
THE REINFORCING STIMULUS

(Order No. Mic 61-2876)

Robert E. Taylor, Ph.D.
The University of Tennessee, 1961

Major Professor: W. O. Jenkins

Ninety undergraduate students were individually exposed to one of six experimental conditions in which the task was to verbalize whether or not a light would be presented. All subjects were administered 72 conditioning trials in a probability contingent paradigm with 72 extinction trials immediately following. The six treatments utilized in conditioning were: (1) 75 per cent reinforcement with a constant color light reinforcer; (2) 75 per cent reinforcement with the color of the reinforcing light

changed on each reinforced trial; (3) 25 per cent reinforcement with a constant color light reinforcer; (4) 25 per cent reinforcement with the color of the reinforcing light changed on each reinforced trial; (5) 25 per cent reinforcement with a constant color light reinforcer plus a constant verbalization by the experimenter coinciding with the illumination of the light; (6) 25 per cent reinforcement with the color of the reinforcing light changed on each reinforced trial and the accompanying verbalization by the experimenter also changed.

The typical partial reinforcement effect emerged when the 75 per cent and 25 per cent groups were compared in conditioning and extinction. No significant differences were evident in conditioning as a function of either the change in the reinforcing stimulus or the verbalization by the experimenter. In extinction, the change in the reinforcing stimulus failed to contribute significant behavioral differences, but the additional reinforcing stimulation of verbalization by the experimenter did yield significantly greater resistance to extinction. All interactions of reinforcement schedule and other stimulus changes were negligible.

The results were discussed with respect to the generalization hypothesis and two possible explanations for the verbalization effect were offered. It was concluded that the partial reinforcement effect findings were again substantiated, but that systematic qualitative variation in the reinforcing stimulus did not produce similar effects in either conditioning or extinction when the probability conditioning technique is utilized. The latter finding is contrary to that proposed by the present investigator and reported by several previous investigators.

Microfilm \$2.75; Xerox \$6.00. 123 pages.

RELIGION

A FORM-CRITICAL STUDY OF THE CULTIC MATERIAL IN DEUTERONOMY: AN ANALYSIS OF THE NATURE OF CULTIC ENCOUNTER IN THE MOSAIC TRADITION.

(Order No. 61-3057)

Walter Brueggemann, Th.D.
Union Theological Seminary in the
City of New York, 1961

The history of the interpretation of Deuteronomy is largely the history of literary analysis which has failed to appreciate the character of the tradition preserved in Deuteronomy. An examination of the material requires a methodology which is compatible with this material which has been produced by an actual cultic community. This study employs the form critical method in its attempt to understand the material in its original *Sitz im Leben*.

The traditions of Deuteronomy can be rightly understood only in terms of the theophanic experience of Israel at Horeb. The cult of the emphictyonic community sought to preserve the validity and vitality of the original encounter with Yahweh. The cultic meetings of this community attempted to protect and affirm the spontaneity and directness of the original meeting so that the freedom and sovereignty of Yahweh might be maintained.

The need for spontaneity creates a problem in defining cultic space. If the encounter may be wherever Yahweh wills, cult cannot be a reliable and predictable thing. On the other hand, if the place is reliable and predictable, there is danger that Yahweh will be confined there and so deprived of his essential freedom. The solution given by Deuteronomy preserves Yahweh's freedom and solves the need for reliability and predictability. An analysis of the definite phrase, "The place where Yahweh shall cause his name to be," reveals that Yahweh is fully present in the cult place; but he is free to leave and cannot be imprisoned there. The fitness of the place is not established by external criteria, but by the character of Yahweh and the response of Israel. Thus the problem of cultic space is solved in personal terms. The legitimate cult place is wherever authoritative hearing and faithful listening can happen. The place corresponds to the place of Horeb where Yahweh spoke through Moses and Israel responded in obedience. The notion of cultic space is resolved in covenant terms; it is where sovereign and servant meet in covenant.

The need for directness and immediacy in cultic meeting pose the problem of cultic time. Yahweh was known directly by Israel at Horeb. But to assume that he would be known in this way in subsequent meetings is to subordinate his free sovereignty to the needs of cult. The answer to the problem must be to find a way in which the present cult meeting can appropriate the validity and vitality of the meeting of Horeb without enslaving Yahweh to the cult establishment.

The solution is discovered in the way in which Yahweh meets Israel directly and immediately at Horeb. He is

known in the theophany by the way he speaks through his mediator Moses. The directness of cult is the same as the directness of theophany. Yahweh is immediately known as he speaks through his mediator. The function of the mediator is the same as it is in the theophany. He makes the sovereign presence and will of Yahweh imperative for the listening community. He mediates the law, the covenant, and the blessings and curses to Israel. He does not merely recite the tradition, but modifies and expands the tradition as it is necessary to make it clear, relevant, and imperative for the assembly. This content must happen in the same context as did the encounter of Horeb. Thus the speaker must be Moses, the listener must be Israel, the meeting must be the assembly of speaking and hearing. Whenever that happens, Yahweh is known immediately by Israel.

The problems of immediacy and spontaneity are resolved when it is seen that the cult is the place wherever the theophany happens again with its original validity and vitality. The tradition of Deuteronomy emerges from a cult which repeatedly appropriates this theophany; thus the lordship of Yahweh is constantly reasserted over the covenant community. The material which has been given literary form is to be explained and understood as the product of a real community in actual encounter with its Lord. The reduction of the material to its present form does not alter the fact that it resulted from the live encounter of authoritative speaking and responsive hearing.

Microfilm \$6.40; Xerox \$22.75. 501 pages.

RELIGIOUS HEALING IN THE UNITED STATES, 1940-1960: HISTORY AND THEOLOGY OF SELECTED TRENDS.

(Order No. Mic 61-1096)

Bryan Crandell Epps, Ph.D.
Boston University Graduate School, 1961

Major Professor: Edwin P. Booth

The dissertation is a descriptive history of three major movements in religious healing in the United States which have been especially prominent during the years 1940-1960. The division of these movements has been made from the standpoint of their respective methodologies, thus distinguishing three approaches: healing through pastoral (religio-psychiatric) counseling, healing through liturgical worship, and healing through applied metaphysics. Part One of the dissertation describes the historical background of each of these three movements, and Part Two presents the theology of healing in each approach, with a final chapter correlating concepts in all three movements. Individual and denominational differences within each approach are recognized.

PART ONE: HISTORICAL BACKGROUND

Religio-psychiatric healing, as represented in the new pastoral counseling, is seen as a movement which has evolved through the continuing interrelationship between pastoral care and the fields of medicine and psychology. Approximately concurrent has been the growth of the movement for the training of seminarians and pastors in clinical settings within medical and other institutions. The rise of church counseling centers and the growth of a corps of clinically-trained hospital chaplains are other manifestations of the growth of the religio-psychiatric approach to healing.

Liturgical healing is considered as healing through formal ecclesiastical rituals such as the Lord's Supper and laying on of hands. This approach to healing has been most prominent among clerical leaders in the Protestant Episcopal Church, the Methodist Church, and the Presbyterian communions, in that order, according to a survey conducted under the auspices of The National Council of Churches of Christ.

Metaphysical healing is considered from the standpoint of Christian Science exclusively, since it has been especially influential in the field of religious healing. In recent years the Church of Christ, Scientist, has maintained considerable philanthropic and wartime relief activities in which healing is central.

PART TWO: THEOLOGY OF HEALING

In all three approaches to healing salvation is viewed as a growth process which may be described in terms of a continuum. The minimal point of the continuum corresponds to hell (sin, alienation, disease, death); the intermediate point corresponds to human experience (with sin and disease being overcome); the optimum point of the continuum corresponds to heaven (reconciliation, beatitude, image of God).

The dynamics of salvation are seen by those within each approach in terms corresponding to their respective methodologies, although those in all three approaches affirm that healing comes from God. In pastoral counseling health is seen as mediated primarily through intensive interpersonal relationships; in liturgical healing as mediated through prayer and sacramental ministrations; and in metaphysical healing as mediated through a perception of ultimate reality disclosed through religious experience.

Conclusions from this study include:

1. There is a vigorous movement within the Protestant churches to explore the relationship of religion to health through ministering to the troubled and sick. Three approaches to healing within this movement may be described as the religio-psychiatric, liturgical, and metaphysical.
2. The principal differences among these approaches exist in their respective views of: the relationship between ultimate salvation and present experience; the necessity of death; the methodology of healing; interprofessional relationships.
3. The principal similarities among these approaches exist in their respective views of: the over-all concept of salvation; the opposition of God to disease; the goal of healing as subordinate to the goal of transformation of the total growth process which is salvation; the place of healing in Christian ministry.

4. The pragmatic basis of each approach indicates the influence of the criterion of empirical authority.

5. Implications arise for Christian soteriology, eschatology, Biblical criticism, and the life and work of the Church. Microfilm \$5.85; Xerox \$20.75. 458 pages.

THE CONTRIBUTION OF
HENRY JOEL CADBURY TO THE
STUDY OF THE HISTORICAL JESUS

(Order No. Mic 61-1095)

Samuel Garlin Hall, Ph.D.
Boston University Graduate School, 1961

Major Professor: Donald T. Rowlingson

Cadbury's basic conclusion about the historical Jesus is that he was a product of his own Jewish environment and, as such, is not to be thought of as unique. His method of teaching can be paralleled with the rabbis of his time. His moral earnestness is comparable to that of the Old Testament prophets. Only in his "excess of virtue" may any originality be attributed to him.

Jesus' religious experience is no different from that of any pious Jew. Revelation came to him through the normal cognitive processes. Nor should one assign to Jesus a conscious plan or well-defined program; his teachings were casual and occasional. The unique theological portraits which successive generations have painted of Jesus are not supported by the evidence.

In such conclusions one is confronted with pressing questions which Cadbury does not answer. If Jesus is to be viewed on a purely human level with neither uniqueness nor originality, and with no conscious plan, what then are valid explanations for the phenomenal impact of his life and message? Cadbury's works, astute and scholarly as they are, appear incomplete in some of these areas. Inasmuch as the evidence is insufficient to reconstruct a completely accurate picture of Jesus, which he admits, is it not gratuitous to conclude that Jesus was no different from his Jewish contemporaries?

Cadbury asserts that Jesus has been made in the image of the twentieth century modernizer. With penetrating criticism Cadbury points out teachings of Jesus which have been held up as blueprints for modern social reform. Jesus is supposed to have envisioned the modern concept of the "Fatherhood of God" and its correlate, the "Brotherhood of Man." Cadbury sees serious limitations in the teachings of Jesus for social issues because the first century attitude was greatly different from that of the modern mind. Jesus did not think in modern social terms. Yet an advantage may be seen in the very fact that Jesus stressed individual rather than group responsibility as a starting point. The individual is to reform society, not the reverse.

In his attempt to recover the historical Jesus, Cadbury utilized some of the techniques of form criticism which he was the first to introduce to English readers. However, he digs deeper yet and calls attention to motives, often submerged or mixed, which led to the preservation and utilization of the gospel materials. Often the conflict of motives can be explained on the basis of the variety in the materials which came down to the final editors. Cadbury

denies any theory of consistent motivation in the writers of the gospels.

Gross exaggerations are pointed out as Cadbury tirelessly works to counteract the modernization of Jesus, and one cannot deny that he has rendered a valuable service. However, that his works are a reaction to theological presuppositions should be recognized. Hence, in his earnestness, he may have pursued his quest to an extreme.

Cadbury maintains that even though they are beset with many difficulties, the gospel records are the primary sources of information about Jesus and must be examined more carefully. Cadbury's ability in lexical studies long has been recognized, as seen in his attack upon Hobart's "proof" of the medical language of Luke. The names of Jesus found in Acts were stereotyped titles for the most part, with no unique significance.

Cadbury is a historian. He has given particular attention to those first century elements which a historical portrait of Jesus requires. He plants within the mind of the serious student enough doubts to cause him to renew investigation of the whole field of New Testament interpretation. This is no small contribution.

Microfilm \$4.05; Xerox \$14.20. 313 pages.

THE BIBLICAL BACKGROUND OF PAUL'S UNDERSTANDING OF FAITH AS OBEDIENCE

(Order No. Mic 61-2416)

Robert Dean Matthews, Ph.D.
Boston University Graduate School, 1961

Major Professor: Donald T. Rowlingson

This study considers the role and nature of obedience in Hebraic religion as prerequisite to an understanding of Paul's conversion experience, his Christ-mysticism, and his rejection of the Law in favor of the submissive act of obedience which is faith. The contention of this study is that anthropological research has been unable to discover the motivating factors in the formation of religious customs and beliefs, which have been disguised by the processes of repression and rationalization. The psychoanalytic method, therefore, has been applied to the institutions of Judaism in chapter two resulting in a more penetrating interpretation.

Traces of totemism are found throughout the Old Testament. A consideration of early Semitic religion enlightened by the psychoanalytic method leads to the conclusion that the Passover is a ceremonial slaying of the god for the purpose of identification by incorporation. The "subsequent obedience" which this ritual produces is so overwhelming that Hebrew religion becomes a way of life in which submission is regarded as the principal virtue. The feast of unleavened bread was a Canaanite agricultural rite attached to the Passover because it centered around the same conception. The feasts are reinterpreted in Judaism as memorials of God's acts in history.

As symbolic castration, circumcision symbolizes complete submission to the father, rendering death wishes harmless in advance. Circumcision thus becomes the sign of the covenant, the prime requirement for participating in

the Passover, and a powerful motivation toward obedience. All forms of sacrifice are regarded as symbolizing parricide. The substitution of animal and plant for human sacrifice marks the first stage of victory of tender feelings over the most primitive fears and impulses of mankind.

The effects of the prophetic protest against the sacrificial cult were not realized until the Exile; but the decreased value thereby placed upon ceremonial rites, which dramatized instinctive impulses, compared with a new emphasis upon individual conduct gave rise to Torah. Observance of the Law, in its turn, became for many a compulsive form of obedience. Jesus renewed the prophetic protest by distinguishing between fulfilling laws and whole-hearted obedience as a voluntary response to a loving Father.

Paul's unconscious dissatisfaction with the Law and his activity as a sadistic persecutor were a prelude to a reaction formation at his conversion, by means of which he was able to repudiate his former loyalty to the Law and transfer his allegiance to the second Adam, whose obedience made salvation possible. In Paul's thought, man is saved by the grace of God rather than by works; and the grace of God operates through faith in Christ, which is granted as a gift. Yet this faith is the result of a definite act of obedience in which man surrenders all attempts to achieve his own salvation.

All this is an integral part of Paul's Christ-mysticism. Man does not come into direct relation with God but identifies with Christ in baptism, which symbolizes death and resurrection and replaces circumcision as the badge of salvation. The old self is crucified with Christ, and the new man is freed from the dominion of the Law and the curse of sin and death. The totem meal is revived in the Lord's Supper. But the sacraments are no "medicine of immortality." Salvation can be lost by rejecting the gospel as originally preached, or by the deadly sins of unchastity, idol worship, or dependence upon the Law for salvation. Paul's synthesis of instinctual drives and an ethic of love made possible a refined and universal religion, appealing to primitive drives in man's psyche and yet challenging his ethical capacities to the utmost.

Microfilm \$2.75; Xerox \$7.20. 152 pages.

THE SELF AND CHRISTIAN EDUCATION: A CRITICAL ESTIMATE OF THE USEFULNESS OF CERTAIN LEADING PSYCHOLOGIST'S CONCEPTS OF THE "SELF" FOR EDUCATORS FOLLOWING THE OBJECTIVES OF CHRISTIAN EDUCATION OF THE NATIONAL COUNCIL OF CHURCHES.

(Order No. Mic 61-2564)

Elmer Henning Ost, Ph.D.
New York University, 1961

Chairman: Professor Lee A. Belford

Problem: To determine the degree of usefulness to be ascribed to the self as defined by representative personality psychologists for the understanding, development, and functioning of personality as projected by objectives of Christian education.

Procedures: Fifteen theorists who used the concept of the self were selected from the twenty authors reviewed by Hall and Lindzey in *Theories of Personality*, their recent survey of current representative theories of personality. Christian education data were derived from the three most recent statements of objectives published by the National Council of Churches: *Junior High Objectives*, *The Objective for Senior High Young People*, and *The Objectives of Christian Education*.

As used in this study the self referred to aspects of personality and to the body of theory describing those aspects. For purposes of measurement three areas of usefulness were defined: contexts of the self; definition of the self (in terms of structure, development, and functioning); and the estimated dynamic functioning of the self (i.e., the effect of theory from psychology on theory in Christian education, and the effect of the self on the pupil). For each area, a hypothesis of usefulness with strong limitations was proposed, and a five point rating scale by which usefulness could be estimated was prepared.

Findings and Conclusions: Five theorists used the term self to designate the highest quality of the whole personality: selfhood. Ten used it to designate four aspects of personality: central processes, pictures of oneself, valuations of oneself, and a complex organization of processes, pictures, and values which enhances or defends the individual.

For each of the three areas of measurement, usefulness with strong limitations was discovered. Contexts were not in complete agreement, but the substance of psychological data was judged to be near enough to that of Christian education items to have limited usefulness. Unanimity in definition of the self in psychology was nearly complete for development and functioning, but for structure there were two groups of five and ten (as noted above). The data on definition was therefore judged more useful than had been predicted. In the area of the dynamic functioning of the self psychological theory supported Christian education theory very strongly in its emphasis on the centrality of awareness in motivation and guidance of behavior. However, psychology offered only the most meager data by which Christian education could be guided in the identification, development, or modification of a desired self.

In general, the hypothesis of limited usefulness proposed in the study was supported by the data. Greater usefulness than had been anticipated was found in the unanimity of definition of development and functioning, and in the support the Christian education's stress on awareness in its personality theory.

Further research is needed at the crucial points of identifying and achieving the self which will enhance the development of personality desired by Christian education.

Microfilm \$3.85; Xerox \$13.50. 298 pages.

**THE GENIUS OF THE CHRISTIAN RELIGION:
A STUDY IN THE RELIGIOUS THOUGHT
OF GEORG WILHELM FRIEDRICH HEGEL.**

(Order No. 61-2927)

Charles J. Ping, Ph.D.
Duke University, 1961

Supervisor: Robert E. Cushman

The subject is an examination of the reconciliation of revelation and reason attempted by Georg W. F. Hegel. The philosophy of Hegel is interpreted as a speculative religion offering both a comprehensive world view and a salvation doctrine.

It was Hegel's judgment that the Christian religion is the fulfillment of the idea of religion--absolute and perfect religion. This evaluation was based upon what Hegel understood to be the genius--the peculiar endowment, the unique content--of the Christian religion. The consideration of his interpretation of the genius reveals the content of his religious thought.

For Hegel, the idea of the Christian religion represents the union of the whole of human and divine Mind, but the form in which this Idea is expressed in the Christian tradition is imperfect. Specifically, Idea is associated with abstract theological formulae and with historical, imaginative pictures. Hegel attempted to state the Christian religion as an expression of Absolute Mind. To perfect this statement, it was necessary, he believed, to transpose the limited forms of the religious consciousness into the rational form of concrete, self-determined Idea.

The first of the three parts of this dissertation introduces Hegel's religious thought by placing it in the context of his own philosophical system. This part includes, in addition, the consideration of Hegel's presentation of the idea of religion, historical religions, and absolute religion.

The body of the dissertation is devoted to the Hegelian interpretation of three central Christian doctrines: God, the Incarnation, and salvation. Under the impetus to present idea content, these doctrines were radically restated by Hegel to signify the idea of the triune character of reality, the idea of the union of the human and divine Spirit, and the Idea in community--the reconciliation of finite and Infinite Mind.

The final part of the dissertation focuses upon the general problem of the interpretation of Christianity as Idea. The relation of form and content is considered, and, finally, the relation of absolute idealism to Christian thought is considered.

Despite his avowed intention to preserve the true content of the Christian religion while giving it a new and more adequate form, in giving it a new form, Hegel did in fact give a new content to the Christian religion, a content which radically contradicts traditional Christian thought. The contention is that this is true precisely because content and form cannot be separated; form expresses content. The assumption of the essential continuity of human reason with Ultimate Reality and the construction from this assumption of a fundamentally timeless, determined system, reflecting the self-confidence of reason, necessarily bring the world view of absolute idealism and the Christian religion into irreconcilable conflict. The positive implication of this is that the form of the Christian religion--its personal, historical confessional character--is of the

essence of its content. This conclusion is established in the dissertation by the examination of what happens to the content of the Christian religion when it is interpreted in the form of idea content.

Microfilm \$4.40; Xerox \$15.55. 344 pages.

**A CONTEMPORARY PROTESTANT CRITIQUE
OF THE NATURAL LAW TRADITION**

(Order No. 61-2928)

Isabel Wood Rogers, Ph.D.
Duke University, 1961

Supervisor: Waldo Beach

The problem to which this dissertation is addressed is a perennial question in Christian ethics: to what sources shall Christians turn to find guidance for social decision? The New Testament proclaims a Gospel ethic which seems more relevant to unilateral than to multilateral neighbor relations; where, then, can Christians find criteria for making ethical judgments of public policy? Seeking a supplement for the Gospel ethic, Christian thinkers early turned to the moral consensus of reasonable men, working out the theory of "Christian Natural Law" which received its fullest statement in Thomas Aquinas and has remained fundamental to Roman Catholic social thought ever since. Always, however, there have been thinkers within the Church who have criticized the Natural Law, believing that the man who does not know God in Christ cannot know true justice.

Churchmen in the 20th Century have wrestled seriously with this problem of criteria for social decisions, and there has appeared a real polarity in viewpoints on this matter. The heirs of the Thomistic Natural Law tradition--represented in this study by the Roman Catholic Jacques Maritain--believe that social decisions ought to be rooted in the essence that is human nature, rationally discernible by reasonable men. At the other extreme are those who radically reject the Natural Law, asserting that social decisions must be judged by God's own holiness known through revelation. This viewpoint is represented by the Lutheran Werner Wiesner.

Between these extremes are two Protestants who weave together in greater complexity the elements involved in social decision. Emil Brunner is critical of the Natural Law but believes that we must recognize the reality of a primal moral order which should provide the basis for a theory of justice--the "order of creation," discerned in the nature of man not as he is in himself but as he is created by and responsible to God. Reinhold Niebuhr believes that the exponents of Natural Law do not take sufficient cognizance of the pervasiveness of human sin. Because men are sinful, contends Niebuhr, they need to turn to the encounter with God in Christ, as known in the Bible and in Christian theology, to find the guiding principles for making decisions of public policy.

The author of this study believes that to develop a normative position in this matter one must come to terms with certain theological convictions. First, God is a living, active God, continually and creatively at work in His world; the ethical response required, therefore, is a personal re-

sponse to God rather than the effort to obey moral laws. Second, God is nevertheless a faithful God who acts in an orderly way, creating all men alike with the telos of living in love. This "law of love" is seen most clearly in the Christian revelation, but it is an order to which all men are subject and which all discern in part. Third, sin is ubiquitous in human life; it beclouds man's vision and corrupts his will so that he can neither clearly discern nor fully obey the "law of love." Fourth, love still remains the norm for all of life; it is the norm for man in his collective as well as his individual life.

The norm of agape, then, provides the criterion for social decisions; hence all decisions are relative and sinful, for none ever expresses agape in its purity. In spite of this risk, the Christian must nevertheless act, and he can act in full assurance that a forgiving God will justify him in his faith, that in the overarching purposes of God even the Christian's blunders can be caught up and used.

Microfilm \$3.05; Xerox \$10.60. 235 pages.

**SAMUEL DWIGHT CHOWN: AN ARCHITECT
OF CANADIAN CHURCH UNION.**

(Order No. Mic 61-1107)

Edward Richard Schwarz, Ph.D.
Boston University Graduate School, 1961

Major Professor: Nils Ehrenstrom

In this dissertation the nature and extent of the contribution of Samuel Dwight Chown to Church Union in Canada is examined. There are three parts to the study, a survey of the life and work of Samuel Dwight Chown, a discussion of his activities in the fields of social reform and evangelism within the context of Methodism, and an examination of his interdenominational Church Union activities.

He was born in Kingston, Ontario, in 1853 and was educated in Kingston Public School and the Military College. He later became convinced that he was called to the ministry and, in 1874, became a probationer in the Wesleyan Methodist Church. During his probation he studied for two years at Victoria College and was ordained in 1879.

His pastoral career, 1879-1902, consisted of two phases. The period, 1879-1891, was marked by service in relatively small centers and a strong emphasis upon social reform which at that time was chiefly temperance work. This work contributed greatly to Chown's reputation. The period, 1892-1902, was spent in the urban centers of Montreal and Toronto and was marked by a strong emphasis on the administrative aspect of the church's life. This introduced Chown to the broader problems of evangelism.

Despite its reunion in 1884, Canadian Methodism was still unable to meet the problems of evangelism and social reform and therefore readily joined with the Presbyterians and Anglicans in Union discussions in 1889. Upon the failure of these talks a new approach to Union was sought. To the older union principle of effectiveness was added the principle that all "essential truth," both Biblical and experiential, must be preserved.

In 1902 a Department was established at the General Conference level to integrate Methodist social reform activities, to develop and place new programs into operation,

and to act as liaison between Methodism and other social reform organizations. Chown became its first General Secretary and during his office, which lasted until 1910, the Department made remarkable advances.

Meanwhile, the Presbyterian, Methodist and Congregational Churches appointed committees to explore the possibilities of organic Church Union. The Joint Committee on Church Union met five times between 1904 and 1908 and prepared a "Basis of Union" which they felt preserved "essential truth" while preparing a United Church specifically designed to undertake the evangelism and social reformation of Canada. The actual work was done by sub-committees on Doctrine, Polity, Ministry, Administration and Law. Chown's contribution was made in the sub-committee on Administration. This sub-committee had its report prepared by three members, one from each denomination, and Chown was the Methodist representative. The "Basis" was approved by the General Conference in 1910.

In 1910 Chown was elected to the office of General Superintendent. He was faced with three problems, to resolve the relationship of Canadian Methodism with Ecumenical Methodism, to gain and maintain Methodist support for the Union, and to prevent situations that might jeopardize the Union. Chown succeeded in overcoming subsequent obstacles and Union was consummated in 1925. In this work Chown employed the earlier Methodist principles for Church Union and developed two new ones. He carefully avoided any compromise which, effective for the moment, might hinder further reunions and, in relinquishing his hope of becoming the first Moderator of the United Church, he demonstrated the complete selflessness necessary to make Church Union a success.

Microfilm \$3.95; Xerox \$13.95. 308 pages.

PHILIP SCHAFF'S CONCEPT OF ORGANIC
HISTORIOGRAPHY INTERPRETED IN
RELATION TO THE REALIZATION OF
AN "EVANGELICAL CATHOLICISM" WITHIN
THE CHRISTIAN COMMUNITY.

(Order No. 61-2929)

George Hite Shriver, Jr., Ph.D.
Duke University, 1961

Supervisor: Ray C. Petry

Toward the middle of the nineteenth century there arose within the German Reformed Church in America the Mercersburg school of theology. In the early years of its history Philip Schaff joined the faculty as Professor of Church History. His theological education had been received in three formidable European schools—Tübingen, Halle, and Berlin. He had studied closely the historical method of Augustus Neander, famous Professor of Church History at the University of Berlin.

The young privat-docent from Germany encountered a political and religious turbulence in America which was completely antagonistic to the new organic historiographical principles that he enunciated in his inaugural address at Reading, Pennsylvania, on October 25, 1844. His orthodoxy was challenged, and he was forced to undergo two heresy trials. Being completely exonerated, however, he

spent twenty fruitful years at Mercersburg before moving to New York City and the Union Theological Seminary.

In his The Principle of Protestantism (1844), What is Church History? (1846), and History of the Apostolic Church (1851), Schaff delineated fully his organic historiography. A vital role is played in this delineation by his concept of the realization of an "evangelical catholicism" within the Christian community. This age of Christian and Church union will preserve the best elements of the Catholic and the Protestant traditions. It will be an age of one Shepherd and one flock. The categories of elaboration of this theme are viewed as providential, Christological, and ecclesiastical.

Schaff believed that there must be certain regulating principles and an objective creed for an empirical church which was organically responding to a deeper apprehension of the content of ideal Christianity. Convinced that the creeds of the churches revealed an underlying agreement in their main principles, he wrote his Creeds of Christendom (1877) with the express purpose of cultivating a better understanding among the churches and promoting a richer harmony between denominations by confronting Christians with various creedal forms which did not necessarily deny the truth of one another. Carrying his principles to the practical level of expression, he was active from 1847 to 1863 in the liturgical movement of the German Reformed Church as he edited his hymnal, composed his catechism, and labored faithfully on the synodical liturgical committee. In this same area, he later advocated the revision of the Westminster Catechism as a communing member of the Presbyterian Church. The church at worship and at confession must come to know an irenic, rather than polemical, attitude.

As a teacher of church history Schaff remained faithful to these principles of interpretation throughout his career. His lecture manuscripts, his student's notebooks and reminiscences, and his vast correspondence vividly illustrated his concern to communicate his principles to future pastors, teachers, and denominational leaders. To him this was basic to the practical realization of an "evangelical catholicism."

As editor, agitator, and organizer, this dean of American church historians was active in a program to foster and nurture what he felt to be positive signs of an emerging "evangelical catholicism." His numerous editing projects, his relationship with the Evangelical Alliance, his Chairmanship of the American revisers in connection with the Bible revision of 1885, and his foundation of the American Society of Church History in 1888 were all undertaken with such a program in mind. At the Parliament of Religions meeting in Chicago in September, 1893, he made his final plea for Christian and Church union. Rather naive in his attitude, he nevertheless hoped that the American Church would taste the first fruits of the celestial vision of unity.

Indeed, Schaff was a pioneer in "ecumenics" which must, of necessity, be historical, churchly, and liturgical. His historiography was essentially a Christian understanding of history which included Christological, ecclesiastical, dynamic, and eschatological elements.

Microfilm \$4.65; Xerox \$16.45. 362 pages.

THE JUBILUS THEME IN THE LATER
WRITINGS OF RICHARD ROLLE

(Order No. 61-2933)

Sam Jones Womack, Jr., Ph.D.
Duke University, 1961

Supervisor: Ray C. Petry

This is an interpretative analysis of what is regarded as one of the most prominent and most important themes to be found in the writings which came from the pen of a fourteenth-century English hermit and mystic during the last decade of his life. Richard Rolle, a Yorkshireman, is generally recognized as the "father" of English mysticism.

Here the focus is upon the boundless joyousness that comes to expression in the later writings of Rolle, a joyousness arising from high mystical experience and most adequately symbolized in his jubilus. In Rolle's case the jubilus, which has its own history in Christian tradition, is found to be a silent cry of the heart pouring out its love for its Creator in lyric form. It is a "song" which echoes, Rolle insists, the song of the heavenly choirs of angels endlessly praising the Everlasting King.

An examination of Rolle's employment of jubilus and related terms in his later writings is accompanied by a brief survey of the word's history in Christian usage. Certain conclusions are reached as to the distinction to be made between Rolle's conception of jubilus and that held by at least one great contemporary. Finally, the peculiarities of the Hermit's literary style are cited, along with the theory of a modern scholar as to the purpose behind such methods.

The foundation for Rolle's high mystical experience, the study finds, is an asceticism of the sternest kind, in that he counsels a solitary life of absolute poverty. To the individual whose soul is purged of every other affection there

may be given, through grace, a wondrous experience of God which comes as the crown of the renunciatory life--although it comes only to whom God chooses. For Rolle, it is found, the jubilus, as an aspect of the gifts of calor (fervor), dulcor (sweetness) and canor (melody, or music), is the attestation of the unitive experience.

The examination of jubilus then turns to the conception of Rolle as a psalmist, like his Hebrew predecessor singing the praises of a mighty God of infinite goodness. This characterization of the hermit is intended to emphasize the fact that the mystic's personal experience of the divine presence notwithstanding, the Object of love is still known to be God the Creator. It is the role of the creature to adore, worship and praise.

But, for Rolle as for many another Christian mystic, the guise of worshipper is far from adequate to convey the sense of an intimate, personal communion with God as one to whom the creature is volitionally united in love. So, the analysis of jubilus turns to the strongly personal aspect of a love which is brought to fulfillment in the experience of union. Rolle is characterized as a troubadour singing of his Divine Beloved, standing in sharp contrast to the secular troubadour of the Middle Ages, whose influence, it is suggested, Rolle was consciously attempting to combat.

A consideration of the place that the jubilus occupies in Rolle's conception of his vocatio completes the study. Here is emphasized the uniqueness of Rolle's concept, in which he regards himself as having already begun in the temporal world to fulfill the role that is to be his, after death, throughout eternity: the raising of the jubilus in love and praise. In this activity it is concluded, the roles of psalmist and troubadour are joined. But, lest an impression of wholly "other-worldliness" be given, evidence is cited to show that he had a vital sense of social responsibility; that his love of God included love of fellow man.

Microfilm \$4.80; Xerox \$16.90. 375 pages.

SOCIOLOGY

SOCIOLOGY, GENERAL

STATUS INCONSISTENCY IN RELATION TO
SOCIAL PARTICIPATION AND POLITICAL
ACTIVITY IN A BOSTON NEGRO COMMUNITY:
AN APPLICATION OF THE STATUS
INCONSISTENCY CONCEPT TO THE STUDY
OF A LOCAL COMMUNITY.

(Order No. Mic 61-714)

Akinsola Ayodele Akiwowo, Ph.D.
Boston University Graduate School, 1961

Major Professor: Frank L. Sweetser

The hypothesis from which this Study sprang was first proposed by Professor Gerhard E. Lenski (1952) of the University of Michigan in his quest for the true nature of American social classes. It maintains that the structure

of human groups normally involves the coexistence of a number of parallel vertical ranks or level which imperfectly fit together. Also, it maintains that individuals occupy a number of status levels in the major structures which, when viewed from a non-vertical dimension, assume a high or low degree of status crystallization. Those individuals with a low degree of status crystallization differ significantly in their social and political attitudes and behaviors from those with a high degree of status crystallization. Professor Lenski then conducted a survey of residents in the Greater Detroit Area, Michigan. He used a derived statistical formula as a tool to separate the residents into two groups in accordance with their degree of status crystallization. He then set a number of variables against these two groups with significant results.

An attempt was made in the present Study to apply the status crystallization concept, called here the status inconsistency concept, in a Study of social participation

and voting behavior in a local community in Boston: the Negro section of Roxbury, Boston.

The research method is described in detail. The unit of Study here was the Negro male head of household between the ages 25 and 65 years. A random sample of 100 respondents was drawn but only sixty-five were interviewed. Using a different criterion from that employed by Lenski, the investigator divided the local community into three groups: Consistent Status Rank Group, Somewhat Inconsistent Status Rank Group, and Highly Inconsistent Status Rank Group. The first and third Groups are, respectively, the approximate counterparts of Lenski's high and low degrees of status crystallization.

A somewhat extensive survey of the literature was undertaken in the fields of social stratification and voting behavior. And a list of significant findings was presented.

This Study was designed to test the hypothesis: that status inconsistency is inversely related to membership in voluntary associations but directly associated with participation in voting and preference for change in the social order.

Our findings indicate that in the Northern local Negro community of Boston, the members of the Highly Inconsistent Group tend to maintain a fluid marginality between the "colored world within" and the "white world without." They manifest attitudes and behaviors similar to those described as possessing a low degree of status crystallization.

The findings also indicate that the members of the Consistent Group in the Northern local Negro community tend to manifest attitudes and behaviors similar to those whom Lenski called the high status crystallizers.

With respect to change in the distribution of power in the social order, the former prefer changes in those areas where social control is exercised over the prestige system. And the latter prefer changes in those institutions where their economic security is curtailed.

Although members of the Highly Inconsistent Group tend to participate more in State elections, there is no significant difference in the way members of the three Groups vote. A majority of each Group seemed to prefer the Republican Party. However, more Highly Inconsistent Group members voted mixed tickets than did those of the Consistent Group.

Microfilm \$3.20; Xerox \$11.25. 247 pages.

A MATHEMATICAL MODEL OF THE PERSONNEL STRUCTURE OF LARGE-SCALE ORGANIZATIONS BASED ON MARKOV CHAINS

(Order No. 61-2923)

John William Merck, Ph.D.
Duke University, 1961

Supervisor: Alan C. Kerckhoff

The function of personnel management in modern, large-scale organizations has become tremendously complex and critical. The growth of human organizations, in both size and complexity, has placed the personnel manager in the position of having to plan the acquisition, mobility within the social structure of the organization, and

loss of large numbers of individuals representing a multitude of specialized skills. In general, the control required has been achieved through bureaucratic systems in which management is implemented through the issuance of policies governing categories of individuals rather than individuals as such.

The study had two primary goals. The first consisted of a comparison of the conditions under which bureaucratic administrators actually operate, and the conditions often ascribed to bureaucratic operations. The difficulty of evaluating the complex results of personnel policy changes led to the second goal of the study, a mathematical model of a personnel system capable of stimulating the movement of individuals through the system. The study was carried out with reference to the personnel system of the United States Air Force.

A careful scrutiny of the conditions under which personnel administrators work indicated that there are many limitations to the rationality frequently ascribed to bureaucratic management. First, the administrator does not have complete control over the system. Limitations are imposed by "extra-bureaucratic" controls from two major sources: (1) each organization operates within a larger social framework and many controls are imposed by the larger organization; and, (2) certain aspects of the social system tend to become institutionalized, causing attempts at policy control to endanger the entire system. A second limitation to the exercise of rational control lies in the complexity of the set of policies which regulate the system, and the inability of the administrator to evaluate the full effects of a given policy change.

It was found that the movement of people through the Airman structure of the Air Force could be conceptualized as a Markov chain in which the states were defined on the basis of combinations of characteristics pertinent to administrative decision-making, and in which the probabilities of state to state movement were based on empirical observations of movement in the recent past. The magnitude of the computational problem that arose was overcome by two developments: First, it was shown that successive multiplications of the vector representing the distribution of the starting population into the matrix of probabilities of movement required far fewer computations than the number involved in the traditional procedure. The second development consisted of programming the model for computation on an IBM 650 electronic data processing system. These developments permitted the computation of a one-year projection of a 253 state model in less than one minute.

The speed with which projections could be computed made it feasible to introduce methods by which personnel administrators might make tentative changes in certain probabilities of movement in order to evaluate the effects of those changes. This made it possible for administrators to evaluate, almost immediately, the adequacy of a given personnel policy change in producing a distribution of personnel desired at some future time.

In addition to the projections described, the model provides a convenient conceptual arrangement of the personnel system, providing personnel management agencies with a common basis for communication. Moreover, it tends to make clear the points at which the system is susceptible to policy control. Although many improvements may be envisioned it appears that, in its present state, the model presents a practical solution to one of the major problems confronting personnel managers in large-scale organizations today. Microfilm \$2.75; Xerox \$8.00. 173 pages.

THE ECONOMIC ORGANIZATION OF A
RELIGIOUS COMMUNITY

(Order No. Mic 61-2056)

Solomon Poll, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dorothy Swaine Thomas

This is a study of an ultra-religious Jewish group, The Hasidim, who migrated to the United States after World War II and settled in Williamsburg, a section of Brooklyn in New York City. The members of this group consider the main object of their existence the perpetuation of Yiddishkeit, traditional religious Judaism through Hasidic behavior. They pattern their behavior on dogmatic religious beliefs of a highly conservative sort.

In a dynamic metropolis with its many ethnic groups, the Hasidim rigorously oppose acculturation to American social patterns. Resistance to Americanization is such that although there is no physical barrier to isolate the group, there is a strong cultural barrier which separates them from activities which might promote contact with divergent values and styles of life. The group structures all its institutions and its economic activities in such a way that they are conducive to its way of life. The family, religious organizations, social stratification, religious leadership and other phases of the group's social structure are oriented to the preservation of group norms and only those patterns of behavior which reflect Hasidic values and attitudes are sanctioned.

The dissertation compares the Hasidim with other religious minority groups; it describes the structure of the Jewish community in Hungary and compares the religious organization of the wider Jewish community in the United States with that of the Hasidim. It describes the transfer of Hasidic culture to the United States and the subsequent fight against assimilation.

The major part of this study is focused on the economic activities of the Hasidim, which are so structured that even apparently secular elements tend to hold religious significance. This transformation of what might seem superficially to be purely economic activities into religiously significant actions has two major functions: 1) to provide the economic base essential for group isolation and 2) to intensify group cohesion by providing a means of constantly reaffirming group values and group behavior in everyday living. Furthermore, the Hasidim utilizes the urban setting and its characteristic economic system in such a way that they do not limit or destroy the Hasidic way of life but contribute positively to its further growth and development. Detailed data, which are presented, clearly indicate that the manner in which Hasidic Jews make a living is determined by their religion and that the religious connotation both of production and of consumption are critical factors in group self-identification and perpetuation.

Microfilm \$5.40; Xerox \$19.15. 424 pages.

SOCIAL CONTROL AND WAR: AN ANALYSIS
OF SOCIAL CONTROL THEORY IN
INTRODUCTORY SOCIOLOGY TEXTBOOKS
AS RELATED TO INTERNATIONAL CONFLICT.

(Order No. 61-2930)

Ray E. Short, Ph.D.
Duke University, 1961

Supervisor: Hornell N. Hart

Primarily this study formulates and analyzes the contributions and gaps in the sociological data currently being offered to students of general sociology through the treatment in recent introductory textbooks of (1) international war as a form of corporate conflict and (2) social control as the sociological concept offering prospective measures for controlling or restraining deviant conflict behavior in individuals and social groups.

Four principles have guided the research: analysis of previous scholarly research; utilization of "verifiable definitions"; informal induction from observed instances; and formulation of verifiable procedures capable of repetition with reasonably similar results by any competent operator. Forty-three textbooks--published from 1946 to June, 1957, and self-defined as introductory sociologies--were selected, and a "textbook analysis technique" was developed to determine the nature and extent of their treatment of social control and of war-related concepts. Studies were made of two time-divisions of the post World-War-II period, comparing textbook publication dates, means of the percentages of page coverage, texts with more than one edition, the frequency distribution of percentage scores of page coverage, and the correlation between coverages of social control and war. A schedule of forty-one war-related concepts was constructed for rating individual textbook coverages.

Results of the research indicate the following: (1) While both common knowledge and systematic sociological analysis indicate that war-making technology has developed at accelerating rates, no comparable increase (and more probably a slight decrease) has occurred in the sociological attention being devoted to war and social control in the introductory textbooks. (2) No evidence was found indicating any imminent prospect for narrowing this cultural-lag gap. (3) While some sociologists give war as much coverage as 8.07 percent of their pages, a considerable number virtually or completely ignore this subject. (4) Textbooks which contain war coverage vary widely in the sources utilized and materials emphasized. (5) While certain sociologists give social control as much coverage as 8.45 percent of their pages, a considerable proportion virtually or completely ignore it. (6) While any practicable or proposed measures for avoiding or mitigating war would by definition constitute a form of social control, and while recognition of the significance of war as a paramount form of social conflict would seem to imply the importance of developing methods to control such inter-nation behavior, no significant correlation ($r^2 = .005$) was discovered between textbook page-space coverages of social control and of war. (7) Only 18.6 percent of the textbooks devote above-average coverages to both topics, while a considerable proportion virtually or completely ignore both social control and war.

An analysis and classification of the genera and differentiae (agents, objectives and controlees) in 44 social control definitions offered in introductory sociologies and standard sociological reference works indicate: (1) There is a marked lack of consensus as to how this widely employed concept is to be defined, and (2) A corresponding need for reasonably standardized criteria for distinguishing social control from other forms of human control. (3) A large proportion of the textbooks neglect the fact that social control generally operates through individuals. (4) A corrected composite definition is: Social control constitutes the interaction processes by which any society, subgroup or individual influences the behavior of any other individual, subgroup or society toward conformity with previously-sanctioned social norms accepted by either the controlling agent or the controlee.

Further analysis shows that numerous aspects of the control process tend to be classed together as "means" in textbook classifications, and that the generally contrasting control methods predominant in dictatorial (coercive) as against free democratic social orders may be postulated as oppositely skewed distributions on the normal probability curve.

While the introductory textbook is generally considered a primary medium for presenting sociological information and insights to college students and through them to the general public, apparently the professional responsibility to offer a survey of factual information relative to the control of war is largely unfulfilled.

Microfilm \$3.80; Xerox \$13.50. 296 pages.

SOCIOLOGY, FAMILY

CORRELATES OF THE ACCURACY OF ROLE-TAKING AND THE CONGRUENCE OF SELF-OTHER IMAGES AMONG MARRIED COUPLES

(Order No. 61-3031)

Elmer Wilbur Bock, Ph.D.

Iowa State University of Science and Technology, 1961

Supervisor: Lee G. Burchinal

The purpose of this study was to investigate the relationships between certain factors considered as independent variables and the accuracy of role-taking by married couples and the congruence of their images of one another. The independent variables were sex, age, spousal age differences, education, spousal educational differences, farm and nonfarm residence, social status, length of marriage and marital strain.

Data were gathered from a probability sample of all families in Greene County, Iowa, in May and June, 1958. In the present study, only those married couples having chil-

dren at home were used. The sample consisted of 177 couples, 97 couples in the nonfarm sample and 80 couples in the farm sample.

Role-taking accuracy was operationally defined as the accuracy with which each spouse predicted his partner's responses to an instrument consisting of nine items. These nine items referred to personality characteristics for which each spouse was asked to rate himself, to rate his partner, to predict his partner's rating of him, and to predict his partner's rating of himself. The summations of the squared differences between predicted ratings and actual ratings for the nine items were taken as measures of role-taking accuracy. Reliability coefficients were computed for the four measures of role-taking accuracy, two measures for each sex.

Congruence of images was operationally defined as the amount of agreement between the self-rating by each spouse and the rating of him made by his partner. Reliability coefficients were computed for the two measures of congruence of images, one measure for each sex.

Marital strain was defined as the degree of disagreement between spousal reports of decision-making practices in the family. For the farm and nonfarm samples there were four measures of marital strain: child care, management of money, major family decisions, and social activity. For the farm sample alone, there was an additional measure of strain in the area of farm management. Reliability coefficients were computed for each of these measures of strain.

The measures of the dependent variables were significantly correlated. The role-taking accuracy of one spouse was related to that of the other spouse; the congruence of wife's self-image and the husband's image of her was related to the congruence of the husband's self-image and the wife's image of him; and the accuracy of role-taking was related to the congruence of images.

The majority of the predictive hypotheses regarding the relationships between the independent and dependent variables failed to be supported. However, some of the statistical tests were significant. Significant sex differences were found in the congruence of images for the nonfarm sample but not for the farm sample. Ages of wives were significantly related to the congruence of their images of their husbands with the husbands' self-images. Both age and educational levels of husbands were significantly related to the accuracy with which the husbands predicted the wives' ratings of them. The measure of marital strain in the area of child care appeared to be significantly related to the dependent variables for the couples in the nonfarm sample but not for those in the farm sample. The remaining hypotheses failed to be supported.

Failure to find support for the majority of the hypotheses was attributed principally to the inadequacies of the measures of role-taking accuracy, congruence of images and marital strain. Some suggestions were offered for future research in this area, involving the development of more adequate measures and the replication of studies to test the hypotheses proposed in the present research.

Microfilm \$2.75; Xerox \$5.60. 111 pages.

SPEECH - THEATER

AN EXPERIMENTAL STUDY OF THE INTERACTION OF ARTISTIC AND NON-ARTISTIC ETHOS IN PERSUASION

(Order No. 61-3079)

Kenneth Eldon Andersen, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Winston Brembeck

It was the purpose of this study (1) to provide a new set of scales in a semantic differential constituting an empirically derived, multivariate measure of ethos; (2) to provide a scale to measure authoritativeness; (3) to investigate the interaction of non-artistic and artistic ethos, defined respectively as the image of the speaker held by the auditors prior to the speech, and as the image of the speaker created by the speech; and (4) to investigate the effect of ethos in persuasion.

Several specific measuring instruments were constructed. New scales in a semantic differential were derived from the literature on ethos. These 22 scales were applied by 130 beginning speech students to 16 famous individuals. Scale judgments were correlated and summed over subjects and concepts. The correlation matrix was factor-analyzed to determine the major factors in ethos. Likert-type attitude scales to measure authoritativeness and attitude toward the topic (parity price supports for farm products) were constructed.

Two speeches and introductions of three different "speakers" were constructed, incorporating variations associated with authoritativeness, and tape-recorded. The stimuli were found to create different images in two pilot studies.

A two-factor design utilizing a two-way analysis of variance to study the main effects and the interaction of artistic and non-artistic ethos was employed. Each introduction was coupled with each speech, creating six experimental conditions. Subjects, beginning speech students at the University of Wisconsin, were assigned to experimental or control groups and blocked for sex and for initial attitude toward the problem.

Analyses of the data produced the following conclusions:

1. Factor analysis of the correlation among judgments in semantic differentials indicated two major factors in the image of the speaker--the evaluative and the dynamism factors. These factors accounted for sixty-one per cent of the variance in judgments. The dynamism and evaluative scales were used as univariate measures and also were combined in a bivariate measure--the T^2 statistic.

2. A Likert-type attitude scale incorporating concepts held to be related to authoritativeness achieved split-half reliabilities of .96 and .99 in two studies.

3. Non-artistic and artistic ethos were not shown to affect persuasion within the limits of the topic selected, the design of the experiment, the subjects employed, and the levels of the statistically significant differences in ethos produced by the variations employed.

4. Interaction between non-artistic and artistic ethos was shown to be a significant factor in the determination of the terminal ethos of the speaker. The effect of combining artistic and non-artistic ethos cannot be predicted accurately by treating these elements as independent or additive in nature.

5. Tests of related hypotheses indicated that women were not more persuasible than men and that shift in attitude correlated negatively with prior attitude.

Microfilm \$2.75; Xerox \$9.00. 200 pages.

AN INVESTIGATION OF THE RELATIONSHIP OF ARTICULATION AND TIME TO SPEECH INTELLIGIBILITY AMONG TWO GROUPS OF LARYNGECTOMIZED SUBJECTS

(Order No. 61-3260)

John Francis Font, Ph.D.
University of Pittsburgh, 1961

Thirty esophageal speaking subjects and 30 users of artificial means of voice production were randomly selected from a population of 220 laryngectomees who were utilized in an earlier study. All of the subjects were adult males. Each subject tape recorded a different randomized version of one of the Harvard PB word lists, as well as a 101 word paragraph. These recordings were later played back to several groups of auditors who assessed intelligibility for words, intelligibility for paragraphs, word articulation, and finally, the length of time it took, in seconds, for each subject to read the paragraph. Appropriate measures were utilized to assess listener reliability which was found to be quite high for each of the various listening tasks.

The average word intelligibility score for the esophageal speakers was 56.3, while for the artificial appliance users it was 39.9. This obtained difference was significant beyond the .01 level of confidence. The average paragraph intelligibility score for the esophageal speakers was 55.0, and 65.7 for the artificial appliance users. The difference in the scores for this measure was not statistically significant.

In order to assess the contribution of articulation and time to these intelligibility measures, a multiple correlation technique was utilized. Three multiple correlations were performed with each criterion measure. First, the combined effects of the percentage of correctly produced total consonants, and the length of time taken to say the paragraph were assessed in relationship to each criterion measure. Second, the percentages of correctly produced consonants in each of the major sound categories were correlated with each criterion. These categories consisted of fricatives, stop-plosives, nasals, glides and semi-vowels. Finally, the major error types were computed and assessed through multiple correlations in terms of their

specific contribution to the variance associated with either criterion. For the esophageal speakers, total correct consonants, substitutions and omissions, and fricatives offered the greatest percentages of variance associated with word intelligibility, while for paragraph intelligibility, total correct consonants, distortions and undetermined errors, and fricatives accounted for most of the variance. For the artificial appliance users, total correct consonants, substitutions, and fricatives accounted for most of the variance associated with word intelligibility, while total correct consonants and undetermined errors accounted for most of the paragraph intelligibility variance. These results suggested that the specific influence or error types or consonant types on intelligibility seem to vary with the nature of the intelligibility testing material. These results further suggest that the contribution of consonant types and error types to intelligibility may, in addition, vary as a function of vocal quality, since there were differences in these influences among speaker groups.

The articulation analysis consisted of identifying and tabulating the frequency of correctly produced consonants and types of errors produced by the speakers. The consonants correctly produced by the esophageal speakers and ranked according to frequency of correct production were the nasals, stop-plosives, blends, semi-vowels, fricatives and glides. For the artificial appliance users the rankings were glides, semi-vowels, nasals, stop-plosives, and fricatives.

In terms of errors, the esophageal speakers produced the following types of errors: substitutions, omissions, undetermined errors, and distortions. These were ranked according to frequency of production. Similarly, for the artificial appliance users, the errors ranked as follows: substitutions, undetermined errors, omissions, and distortions. The artificial appliance users produced significantly more errors within each of the error types with the exception of omissions. The substitution type of error was clearly the outstanding error type for both groups of speakers and analysis revealed that many of these errors resulted from either confusion of the surds and sonants, particularly among the cognates, or the production of additional consonants, oftentimes changing entirely the meaning of the word. A discussion of these findings presented a possible relationship between the voicing methods employed by the speakers and the types of errors committed. Microfilm \$2.75; Xerox \$8.80. 195 pages.

THE EVALUATION AND FITTING OF TRANSISTORIZED HEARING AIDS

(Order No. Mic 60-4801)

Dean Allen Harris, Ph.D.
The University of Oklahoma, 1961

Major Professor: John W. Keys, Ph.D.

The need for a general review of the clinical procedures utilized for evaluating hearing aids on hard-of-hearing patients has become quite apparent in recent years. It is recognized that testing procedures must discriminate differences among hearing aids where these differences may be critical to the patient's electroacoustic needs.

The aim of the present study was to seek data relative to four basic questions. These questions involved: (1) the test-retest consistency of speech threshold and discrimination tests using two methods to adjust the gain control of each instrument prior to test presentation; (2) the desirability of selective amplification, using hearing aids with a flat response, a gently rising high frequency response and a sharply rising high frequency response; (3) aided thresholds for narrow-band filtered thermal noise; and (4) the ability of the patient to select for himself an instrument suited to his needs. Subjects were grouped by type and configuration of hearing loss to include flat conductive, sloping conductive, flat sensori-neural and sloping sensori-neural hearing losses, with 10 subjects in each group.

The results of the investigation suggested that significant improvement could be achieved in the consistency of the aided speech reception threshold if the gain control of the hearing aid under test was adjusted to allow the patient to detect a pulsed signal consisting of filtered thermal noise with cut-off frequencies of 500 and 2000 cps. In addition, it was found that the three frequency response patterns of the hearing aids resulted in significantly different discrimination scores in some, but not all instances. Significant differences were not generally noted where audiometric configuration was analyzed. Instead, subjects with conductive lesions obtained better speech discrimination scores with a flat amplification pattern than they did with a sharply rising high frequency pattern. In contrast, subjects with sensori-neural lesions discriminated speech best with either a gradually rising or a sharply rising high frequency response than they did with a flat response, regardless of the configuration of their audiograms. Investigation of the concept of using an aided audiometric configuration to determine the adequacy of a particular hearing aid response revealed no consistent relationship between the aided configuration and the ability to perceive speech stimuli. In assessing the ability of a patient to select an adequate instrument for himself, the subjects were found to be poor judges of the suitability of a given hearing aid toward meeting their individual needs. The experimental subjects, even though experienced hearing aid wearers, generally preferred an aid other than the one with which the best speech discrimination score was obtained.

Microfilm \$2.75; Xerox \$8.80. 193 pages.

THE EFFECTS OF SITUATIONAL DIFFICULTY AND SITUATIONAL PARTICIPATION ON ANTICIPATORY ANXIETY AND OVERT STUTTERING

(Order No. 61-3266)

Jay W. Lerman, Ph.D.
University of Pittsburgh, 1961

This investigation was designed to determine whether stutterers' levels of anxiety, associated with anticipation of talking, will vary in anticipation of different speaking situations; whether this variation in anxiety level can be measured by use of the Discomfort-Relief Quotient (DRQ); and whether there is a relationship between the amount of stuttering and the degree of anxiety in the anticipation of the situation.

Twenty subjects, previously diagnosed as stutterers, were utilized. Ten were in the experimental group and ten were in the control group. The subjects in the experimental group were interviewed concerning their feelings about entering into several different speaking situations. Four speaking situations varying in difficulty were used. The interviews were conducted (a) prior to entering the situation the first time; (b) while under the impression that they were about to enter the same situation an eighth time. Interpolated between these two interviews, the subjects actually entered the situation seven consecutive times. The subjects did not enter one of the situations, but gave their anticipations to the situation while under the impression they were about to enter the situation. This situation was used as a test-retest situation, the second anticipation for this situation occurring seven days later.

The procedure for the control group was generally the same as that for the experimental group, with the following exceptions: (a) the subjects in this group did not enter any of the situations, although they were under the impression that they were about to enter the situation; (b) the second DRQ for the various speaking situations was taken one week later.

The situations used, progressing from the most difficult to the least difficult, were (a) the subject telephoning to ask a price, train fare, etc.; (b) the subject introducing himself (face to face). This situation was not participated in by the experimental group; (c) the subject telling a person a message from someone else; and (d) the subject buying something from a store clerk.

Various measures were made on each subject. These measures were a DRQ for each verbal anticipation; frequency of stuttering for each anticipation; and number of words in each anticipation. These measures were then treated statistically.

On the basis of the results found, it was concluded that:

(A) In terms of the present study, repeated participations in the same situation did not significantly change the anticipatory anxiety level in a group of stutterers;

(B) No statistically significant differences existed among the situations used in this study as based on the Discomfort-Relief Quotient. This raises questions about the representativeness of the rankings of the situations used in the study;

(C) It was difficult to ascertain the reliability and validity of the measuring instrument used in this study. However, in the final analysis, the reliability and validity of the Discomfort-Relief Quotient can neither be accepted or rejected on the basis of this study;

(D) The frequency of stuttering in an interview and the degree of anxiety, as measured by the DRQ, did not have a positively significant correlation. This does not tend to support the validity of the DRQ.

(E) No significant relationships are present between the number of words a stutterer uses in verbalizing his anticipation to a situation and the level of anxiety as measured by the DRQ. These data suggest a stability of the DRQ in respect to length;

(F) No significant relationships exist between the frequency of stuttering and the level of difficulty of the situations. These data also raise questions about the representativeness of the rankings of the situations used in this study.

Various hypotheses were discussed as possible explanations of the results obtained in this study, and areas for additional research were suggested.

Microfilm \$2.75; Xerox \$3.80. 66 pages.

THE EFFECTS OF RATE OF ATTENUATION AND MODE OF SIGNAL PRESENTATION UPON THE AMPLITUDE OF THE BÉKÉSY ENVELOPE

(Order No. 61-3267)

David Joseph Lilly, Ph.D.
University of Pittsburgh, 1961

Supervisor: Aubrey Epstein

The Problem. Békésy first introduced his automatic-audiometer in 1947. Numerous investigators have attempted to predict the presence or absence of recruitment of loudness on the basis of the amplitude of the envelope which is traced as a subject records his threshold responses with this audiometer. To date, such attempts have resulted in a margin of error that is too great to permit accurate differential diagnosis.

On the basis of clinical and theoretical evidence it was hypothesized that a change in two of the operating conditions for the Békésy task might provide a better measure for recruitment. Specifically, the objective of the present study was to determine the effects of the rate of signal attenuation and the mode of signal presentation upon the amplitude of the Békésy envelope for three groups of subjects.

Subjects. The three treatment groups were composed of: (1) subjects with normal hearing, (2) subjects with a decrease in auditory sensitivity, but no evidence of recruitment, and (3) subjects with a decrease in auditory sensitivity and evidence of recruitment for the four frequencies tested. The alternate, binaural loudness balance test was used to determine the presence or absence of recruitment of loudness.

Procedure. Each subject responded to 32 different signal conditions. These 32 conditions resulted from four rates of attenuation (1, 2, 3.5, and 6 db per second), two modes of signal presentation (continuous and interrupted), and four frequencies (500, 1000, 2000, and 4000 cps). The mean amplitudes of the 32 Békésy envelopes were computed for each subject. The data obtained were evaluated, using a repeated measurements design analysis of variance.

Results. For the three treatment groups the amplitudes of the Békésy envelopes increase linearly as a direct function of the increase in the rate of attenuation. At each rate of attenuation the amplitudes of the envelopes for the normal and the non-recruiting groups are approximately the same. When the tone is continuous the width of the envelope for the recruiting group is significantly smaller than the width of the envelopes for the normal and non-recruiting groups. The magnitude of this difference increases with the rate of attenuation.

The widths of the Békésy envelopes are approximately the same for the normal and the non-recruiting groups regardless of whether the tone is continuous or interrupted. For the recruiting group the envelope is wider when the tone is interrupted than it is when the tone is continuous. At each rate of attenuation the widths of the envelopes for the two modes of signal presentation are significantly different, and the magnitude of this difference increases with the rate of attenuation. For the mode of signal presentation variable the variability of the responses is nearly ten

times greater for the recruiting group than for either of the other two groups.

Conclusions. The effect of the rate of attenuation variable upon the width of the Békésy envelope appears to be the most important experimental finding. It is suggested that a comparison of the responses of a given ear at two different rates of attenuation may provide a measure that will permit accurate predictions regarding the presence or absence of recruitment. This "envelope-difference test" should provide a quantitative measure that will be independent of the absolute width of the Békésy envelope.

Microfilm \$2.75; Xerox \$3.60. 62 pages.

**A STUDY OF THE CHANGING VIEWS IN
SELECTED FOREIGN POLICY SPEECHES OF
SENATOR ARTHUR H. VANDENBERG, 1937-1949.**

(Order No. Mic 61-2721)

J. W. Patterson, Ph.D.
The University of Oklahoma, 1961

Major Professor: Albert J. Croft

The purpose of this study was to describe the pattern of thought in the speeches through which Senator Arthur H. Vandenberg expressed his changing concept of America's role in world affairs between 1937 and 1949, and to describe his political role in the development of acceptable and workable legislation to implement these concepts.

These insights are drawn from an examination of selected Vandenberg speeches, placed in the context of related persons, ideas, and social forces operating during this period.

The basic hypothesis on which the study rests is that this twelve-year period included three major phases of foreign policy: the period of world-wide aggression and of American isolationism; the period of war and of American plans for collective security, and the period of cold war and of the American policy of Soviet containment. The importance of Vandenberg's speeches in the context of this study, therefore, lies in the way they represent American ideas on foreign policy during these three phases.

The achievement of the purposes of the study was dependent upon the effectiveness of the processes of selecting, reporting, and interpreting Vandenberg's speeches. The "reporting" phase asks, "What does the speech mean?" The interpretation examines the lines of action, the outcomes, which Vandenberg's persuasion entails.

While Vandenberg's changing positions throughout these twelve years were sincere and deep-running changes, he did not alter the fundamental premises upon which these beliefs rested. Put differently, he carried through this entire period, the following set of ultimate objectives toward the achievement of which he unvaryingly aimed all of his proposals on America foreign policy: (1) national security, (2) maximum sovereignty for the United States, (3) peace with justice, (4) an appropriate check and balance between the executive and congressional branches of the federal government.

The "changes" in his beliefs were changes in the means by which he thought America could best pursue these objectives. These proposed means were: (1) until Pearl Harbor

destroyed his illusions about an isolated America, a policy of strict neutrality; (2) after war came, a concept of collective security operating through the United Nations; (3) with the breakup of the Grand Alliance of World War II, a plan of Soviet containment, advocating the maximum use of American economic and military forces.

Throughout the period, he played the political roles of "compromiser" and "expediter" among competing interests in foreign policy. The changes in his leadership occurred as he worked at different levels of government, and as he worked with a variety of different groups. As an exponent of bipartisan foreign policy, he emerged near the end of his career one of America's real "elder statesman."

Microfilm \$5.70; Xerox \$20.30. 446 pages.

**SOME MOMENTARY EFFECTS OF
AURAL STIMULATION**

(Order No. 61-2918)

Paul Hamilton Roosevelt, Ph.D.
Southern Illinois University, 1959

Supervisor: Dr. Chester J. Atkinson

Similarities seem to exist between visual and auditory phenomena. Positive and negative after-images with changes in saturation and brightness can be produced by rotating a black and white disk with a sector removed for intermittent viewing of an object behind the disk. Also, pitch and loudness shifts have been demonstrated under various conditions of auditory stimulation. Since pitch and loudness may be considered comparable with hue and brightness, stimulation sequences of tone, white noise, and silence were instituted in this study. These sequences seemed analogous to the rotating disk series.

The purpose of this study was to test for loudness and pitch shifts under conditions of intermittent auditory stimulation which would be comparable with changes in brightness and hue of visual after-images.

Experimental conditions consisted of combinations of 1000 and 6000 cps tones, 95 and 116 db intensities of tone, 50 and 100 msec durations of tone, 106 and 116 db intensities of noise, 100 and 400 msec durations of noise with the same durations of silence, and two and four minutes of stimulation by the tone-noise-silence or tone-silence-noise sequence.

Three observers with normal hearing made the following three loudness and pitch matches in each of 112 trials: (1) pre-stimulation match with bursts of tone to the test ear, (2) initial perstimulation match upon introduction of the stimulation sequence, and (3) final perstimulation match after a period of stimulation. Continuous tones to the opposite ear were presented only during loudness and pitch matching. Intensity and frequency measurements were made of the matching continuous tone.

The data were evaluated by analysis of variance and sign tests and a five per cent level of confidence. The following results were obtained:

1. No significant loudness shifts were indicated from pre-stimulation to perstimulation matches. The tone-silence-noise sequence resulted in less intense

loudness matches than the tone-noise-silence sequence in the length of stimulation conditions with the 1000 and 6000 cps tones at 95 db and in the duration of tone condition with the 6000 cps tone at 95 db.

2. Over-all, the tone-silence-noise sequence resulted in less intense perstimulation matches with the 6000 cps tone at 95 db than did the tone-noise-silence sequence but in more intense perstimulation matches at 116 db.
3. The first perstimulation pitch match at 6000 cps in the intensity of tone condition was significantly higher in frequency than the second perstimulation match and both perstimulation matches were higher than the pre-stimulation match. The 116 db tone at 6000 cps resulted in a significantly higher pitch match than the 95 db tone. The pre-stimulation pitch match was significantly lower in frequency than the perstimulation matches for both the 1000 and 6000 cps tones in the length of stimulation conditions. Tones matched in pitch to the 1000 cps tone were significantly higher for four minutes than for two minutes of stimulation.
4. Over-all, pitch shifted upward from the pre-stimulation to the first and again to the second perstimulation match in the tone-noise-silence sequence with the 6000 cps tone. Pitch was elevated from the pre-stimulation to the first perstimulation match then decreased to the second perstimulation match in the tone-silence-noise sequence with the 6000 cps tone.
5. No relationships were observed among pitch shifts which would indicate a complementary pitch comparable with negative after-images in vision.

Pitch and loudness shifts analogous to positive and negative after-images or brightness changes were not demonstrated by this experiment.

Microfilm \$2.75; Xerox \$5.20. 102 pages.

CECIL BROWN: A CASE STUDY IN BROADCAST COMMENTARY.

(Order No. 61-3170)

R. Franklin Smith, Ph.D.
The University of Wisconsin, 1961

Supervisor: Associate Professor Ordean G. Ness

The premise underlying this study was that responsible evaluation of news events is essential in a democracy. The purpose of this study was to analyze the role of broadcast news commentator, Cecil Brown; to determine how responsibly he performed his role, by employing standards of evaluation enunciated by mass media critics and theorists.

Primary materials were personal papers and some five thousand commentary scripts (1940-1958) deposited in the Mass Communications History Center of the State Historical Society of Wisconsin. All scripts were examined to determine Brown's political, economic and personal atti-

tudes. Three topics--Germany, the MacArthur-Truman controversy and segregation--were exhaustively studied, using the classical rhetorical approach, to determine Brown's persuasive methods.

In general, Brown's attitudes toward domestic affairs were liberal; his attitudes toward foreign affairs, internationalist. He devoted more time to foreign than to domestic issues. In the three issues specially examined, Brown revealed intense opposition to the leaders and people of Germany during the war, support of President Truman's recall of General MacArthur, and strong espousal of integration.

Brown's logical evidence consisted principally of testimony, specific instances and illustrations. Psychologically, he primarily employed emotional appeals, "loaded" stereotypes, suggestion and repetition. He drew heavily on personal experience and his status as commentator-prognosticator for ethical proof. His organization of ideas was loose, sometimes distributive, sometimes "logical," and, most often, characterized by repetition of main points. His style, though generally conversational in quality, occasionally showed ornateness; its attribute of directness was probably effective for oral presentation.

Often Brown's commentaries were charged with emotion. On certain topics, such as Germany and the Fascists, Brown "rode a hobbyhorse to death." Brown was sometimes inconsistent in his comments, and showed bias in presenting facts. Of the three topics examined in detail, only on the segregation topic did Brown fully consider other viewpoints.

Though Brown did not always meet the "ideal" standards, he seemed sincere in his beliefs; his broad reportorial experience fitted him for the commentator's role. Certainly, Brown always was a vigorous critic of the contemporary scene.

Microfilm \$5.20; Xerox \$18.45. 407 pages.

EMPLOYMENT OF A SPEECH RECEPTION ANALYZER FOR THE PRESCRIPTION OF HEARING AIDS

(Order No. Mic 60-5932)

Harrison Waldo Wasson, Ph.D.
Louisiana State University, 1960

Supervisor George H. Gunn, Jr.

The purpose of this study was to propose and evaluate a new procedure for hearing aid prescription. This procedure was based upon the development of a new instrument, a Speech Reception Analyzer, which permitted the measurements of a patient's ability to understand speech by various frequency response settings typical of commercial hearing aids.

Adults with hearing losses sufficiently severe to warrant the use of a hearing aid were selected as subjects. Pure tone air and bone conduction thresholds were obtained for each subject by standard audiometric procedures. Speech reception thresholds were assessed for each subject by use of a flat frequency response curve of the Analyzer. Sponadic words were employed in this threshold test. Fifteen articulation tests each comprised

of fifty monosyllabic phonetically balanced words were administered to each of the subjects, one test for each of the fifteen frequency response settings typical of hearing aids.

Comparisons were made of the data obtained through the test procedures to enable evaluation of the utility of the Speech Reception Analyzer. Results of this evaluation

indicate that the Speech Reception Analyzer is quite effective for prescriptions to patients with mixed and perceptive hearing losses, and somewhat less significant for patients with conductive hearing losses. The Speech Reception Analyzer may be used as an effective clinical instrument for hearing aid prescription.

Microfilm \$2.75; Xerox \$4.20. 76 pages.

ZOOLOGY

THE STRAWBERRY LEAF ROLLER COMPLEX IN TENNESSEE

(Order No. Mic 61-2870)

Stelmon Emerson Bennett, Ph.D.
The University of Tennessee, 1961

Major Professor: Arthur C. Cole

The purpose of this dissertation is to report findings from a four-year study of leaf rollers found on strawberries in Tennessee (1956-59).

The strawberry leaf roller complex in Tennessee is composed of eleven species and subspecies representing three families of Lepidoptera, namely the Tortricidae, Olethreutidae, and Phalonidae. The leaf rollers in the order of their importance are Ancylis comptana fragariae (Walsh and Riley), Ptycholoma peritana (Clemens), Olethreutes cespitana Hübner, Sparganothis sulfureana Clemens, Choristoneura rosaceana (Harris), Platynota flavedana Clemens, Tortrix pallorana (Robinson), Argyrotaenia velutinana (Walker), Archips argyrospila (Walker), Ancylis muricana Walsingham, and Phalonia angustana Clemens.

Background material includes a review of literature and the systematics of all eleven leaf rollers. In the systematic section, keys to the adults and larvae are presented.

Three of the eleven forms making up the complex are selected as being most important because of their abundance and the amount of damage done by them. These three are Ancylis comptana fragariae, Ptycholoma peritana, and Olethreutes cespitana. The basic biology of each is thoroughly investigated, and the results are recorded. The fundamental biology of these three selected leaf rollers includes a morphological description of stages, over-all life histories, seasonal cycles, geographical distributions, and known host plants. Pertinent biological facts concerning the other eight complex species are likewise presented.

Ancylis comptana fragariae has four annual broods and overwinters in the larval stage. Ptycholoma peritana has three annual broods and overwinters as a larva. Olethreutes cespitana has four annual broods and overwinters in the larval stage.

Fifteen species of parasites of Ancylis comptana fragariae are recorded, some of which attack other leaf roller species in the complex. All of these are hymenopterous species except one which is a dipterous parasite. A graph is presented that shows the percentage of parasitism for each of the four years of study. These species of parasites in the order of their importance are: Goniozus platynotae

Ashm., Meteorus trachynotus Vier, Anachaetopsis torticiis (Coq.), Temelucha cookii (Weed), Trichogramma minutum Riley, Euplectrus plathypenae How., Oncophanes americanus (Weed), Microbracon gelechiae (Ashm.), Itoplectus conquisitor (Say), Pimpla aequalis Prov., Macrocentrus pallisteri Degant, Ascogaster mimetica Vier, Perilampus fulvicornus Ashm., Brachymeria ovata (Say), and Brachymeria hammari Cwfd. Other known parasites are listed. Diseases and predators of leaf rollers are reviewed.

Insecticidal control test results are given. Several insecticides show a significant reduction of leaf roller larvae. Sevin, Guthion, and Rothane (TDE), in that order, yield the best results. However, all materials used are adequate to good.

Microfilm \$2.75; Xerox \$7.80. 166 pages.

THE BIOLOGY OF THE EASTERN SUBTERRANEAN TERMITE, RETICULITERMES FLAVIPES (KOLLAR), IN WISCONSIN, AND RELATED EXPERIMENTS WITH OTHER SPECIES.

(Order No. 61-3099)

Glenn Rudolph Esenther, Ph.D.
The University of Wisconsin, 1961

Supervisors: Professors R. D. Shenefelt and T. C. Allen

Only recently have termites become a problem in Wisconsin. Previously it had been thought that they could not survive the harsh winter conditions in this State.

Field observations of termite colonies in the Cities of Sheboygan and Janesville were made during 1959 and 1960 to investigate the ability of the termites to withstand severe winter conditions. Subsequent observations of (1) increased termite activity when conditions were moist, (2) the apparent association of termites with decaying wood, and (3) the construction of shelter tubes in the direction of decaying wood led to studies of temperature and moisture conditions favorable to the termites and of termite-fungus relationships. These studies are described in detail.

It is concluded that termites will respond to extreme moisture conditions by vertical migrations, usually moving upward if too wet and downward if too dry. Excessively moist conditions appear to stimulate termites to build porous shelter tubes; excessively dry conditions will stimulate the sealing of holes along the tubes. Termites

survive well at a 20 to 30 per cent moisture content in wood.

Since *R. flavipes* was found to be active in wood embedded in frozen ground, it is concluded that this species can survive subfreezing temperatures. Apparently the critical cold temperature for this termite is between 20 and 25° F. Soil temperatures in this range may limit the northern distribution of this species.

Extensive tests of termite survival showed that certain species of fungi are definitely beneficial to the insects. Since the insects were able to survive in malt agar cultures of fungi for over four months, it is concluded that these cultures contain all the elements for a termite diet and also that, in some way, growth of contaminants is inhibited.

The tube-building activity of termites on trees indicated that the insects might be following a concentration gradient of attractive material associated with decaying wood. This led to the discovery of a water-soluble termite attractant in wood infected with *Lenzites trabea* Pers. ex. Fr. *Reticulitermes virginicus* Banks and *Nasutitermes columbicus* (Holmgren) also respond to the attractant.

Some efforts have been made to develop new methods of termite control. An 0.1 per cent dieldrin, wettable powder, in concrete (w/w) gave 100 per cent control after the insects were exposed to the treated concrete for ten minutes. Also, the insects were lured to their death on a thick paste of the aqueous attractant extract mixed with a 75 per cent dieldrin wettable powder.

Microfilm \$2.75; Xerox \$4.60. 90 pages.

THE TAXONOMIC SIGNIFICANCE OF THE TONGUE MUSCULATURE OF PASSERINE BIRDS

(Order No. 61-3328)

William Gordon George, Ph.D.
University of Arizona, 1961

This is a study of the hyoid bones of 501 species, and of the tongue muscles of 259 species, of perching birds. Hyoid variations of alternative kinds are reported to occur in the shape of the basihyale and the ceratobranchiale, in the manner of insertion of the *M. hypoglossus* posterior and *M. ceratoglossus* posterior, and in the origin of the *M. stylohyoideus*. These variations are described in detail and illustrated, and an attempt is made to establish their functional as well as their taxonomic significance. Evidence is developed to show that the Drepaniidae possess the hyoid adaptations of cardueline finches, and that the Olive Warbler (*Peucedramus taeniatus*) has the hyoid bones, hyoid muscles and jaw muscles of an Old World warbler. It is strongly suggested that *Peucedramus* be removed from the Parulidae and placed in the Sylviidae.

Microfilm \$2.75; Xerox \$6.60. 136 pages.

MORPHOGENESIS OF THE DOWN FEATHER IN THE PRESENCE OF PYRIMIDINES, A RIBOSIDE, AND RELATED COMPOUNDS.

(Order No. 61-3035)

Charles William Gibley, Jr., Ph.D.
Iowa State University of Science and Technology, 1961

Supervisor: Howard L. Hamilton

The purpose of this investigation was to employ various compounds related to components of nucleic acids to see how they would affect alkaline phosphatase and ribonucleic acid during the growth and development of the feather. In addition, the nucleolus was examined closely in an effort to determine what role it might play in morphogenesis and differentiation.

Skin from chick embryos of stages 29⁺ to 33⁻ was grown in tissue cultures containing the following chemicals:

Barbituric acid. This close relative of uracil was inhibitory only at high concentrations (833 µg/ml), and then not consistently. Alkaline phosphatase was active, but splotchy, in centers of affected loci. Peripherally, each feather area was broken into smaller centers of phosphatase activity, as though the morphogenetic field had lost control over outlying zones. The nucleoli were either single and enlarged, or multiple. One possible explanation for these effects is that barbituric acid substituted for uracil and formed a special type of RNA which could not be used for normal growth and differentiation.

Dithiopyrimidine arrested growth of feathers with a corresponding diminution in alkaline phosphatase. The destructive effect was concentrated in the pulp, with concomitant lack of organization in the epidermis. It is possible that dithiopyrimidine interfered with the metabolism of nucleic acids, forming an aberrant RNA. Such a molecule would be unable to direct synthesis of proteins of the right type for continued differentiation.

4,5,6 (5,6,7)-trichloro-1-(β-D-ribofuranosyl)-benzimidazole (TRB) stopped growth at higher concentrations (83.3 and 41.6 µg/ml). Lower levels (20 µg/ml) permitted growth, but not differentiation. Many feather loci were subdivided into smaller centers, indicating weakening of the original field. The nucleoli were either single or multiple. TRB decreased the amount of ribonucleic acid in treated cultures. It was suggested that the analogue interfered directly with synthesis of RNA or formed an aberrant molecule incapable of performing the usual metabolic functions of RNA. In either case diminution of RNA could easily limit production of new proteins and stop morphogenesis.

Puromycin stopped growth at concentrations of 333 to 1.7 µg/ml. At 1 µg/ml, there was growth, but little differentiation. Alkaline phosphatase was present, but less active, and not limited to feather loci. Treated cultures showed a decrease in RNA, particularly in the epidermis. Nucleoli were single and enlarged, or multiple. The addition of puromycin might have halted the formation of new RNA and secondarily limited synthesis of new proteins.

Isoorotic acid, 2,4,6-triaminopyrimidine, 5-bromouracil, 5-nitouracil, and diethylbarbituric acid had no significant effect on development of feathers.

The results of this and a previous investigation (Gibley and Hamilton, 1959) indicate that modifications of the nucleolus accompany changes in normal growth and differentiation of the cell. Usually, there is a corresponding effect on the content of ribonucleic acid. It is probable that the nucleolus (acting through RNA) plays an important role in the development of the down feather.

Microfilm \$2.75; Xerox \$4.00. 75 pages.

A COMPARATIVE STUDY OF TWO
SPAWNING POPULATIONS OF
THE WHITE BASS, ROCCUS CHRYSOPS
(RAFINESQUE), IN LAKE MENDOTA,
WISCONSIN, WITH SPECIAL REFERENCE
TO HOMING BEHAVIOR.

(Order No. 61-3116)

Ross Moody Horrall, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Arthur D. Hasler

The purpose of this study was to examine some aspects of the biology of reproduction in the white bass. The study compared reproductive processes occurring on two spawning grounds (Maple Bluff and Governor's Island) within the same lake.

Major emphasis was placed on the study of homing and on the mechanisms of homing. In conducting these studies, over 5,000 white bass were tagged with Petersen tags and over 3,000 fish were marked by a system of holes punched in the fins.

The seasonal abundance, the sex ratio, and the length and age composition of the spawning populations were followed from 1955 to 1960 on the two spawning grounds. Sampling was conducted by permanently set fyke nets.

Spawning aggregations occurred from late May through June. Two factors were observed to influence the seasonal timing and abundance of spawners: the temperature of the water and the age composition of the population.

Several changes occurred in the composition of the spawning populations during the spawning period. The sex ratio was found to change. The mean length of the samples of both male and female spawners decreased throughout the spawning season. Similarly, there was a decrease in the mean length of representatives from each year class on the spawning grounds. The age composition of the samples of spawners also changed. There was an increase in the percent of the younger fish in the total catch as the season progressed. These changes were regular, and followed similar patterns on both the spawning grounds.

The numerical pattern of recruitment into the spawning aggregations changed during the spawning period. The older spawners were dominant early in the spawning season; their numbers slowly increased until the peak of spawning. The numbers of young spawners, however, increased rapidly from a low initial abundance until they were much more abundant at the end of the spawning period. The time-abundance pattern of spawners on the spawning

grounds tended to be influenced by the relative abundance of the different age groups in the population.

Spawning white bass that were tagged and displaced from their spawning grounds returned with high accuracy to the "home" spawning site. Eight different release points were used, including displacement to the other spawning site. There was a total of 9,071 releases and re-releases made over a five year period. Of the 1,384 recaptures, about 89 percent had "homed" correctly. The evidence overwhelmingly supports that the white bass were homing to a specific spawning ground during the course of a single spawning season.

It was also established that the preference for a specific spawning site was maintained in the succeeding spawning periods by individual fishes. There were 621 recaptures of fish one and two years after tagging, and of these 83 percent were recaptured on the spawning ground where they had been originally captured.

Two possible mechanisms that might be important in homing were examined. 1) The olfactory sacs of 362 white bass were occluded, and these fish released at various points along with a similar number of control (normal) fish. The results suggested that olfaction might be important to the white bass in distinguishing between the spawning grounds; however, other interpretations were also possible. 2) Open-water orientation of white bass was followed by two tracking methods. The field evidence suggested, but again was inconclusive, that the sun might be important as a reference point in aiding the fish to maintain a constant direction of travel. Laboratory studies have established a sun-compass mechanism in the white bass.

Microfilm \$3.00; Xerox \$10.35. 229 pages.

THE NATURAL HISTORY OF THE
MOSQUITOES OF THE WICHITA MOUNTAINS
WILDLIFE REFUGE

(Order No. Mic 61-2719)

William Eugene Johnson, Jr., Ph.D.
The University of Oklahoma, 1961

Major Professor: Dr. Cluff E. Hopla

Due to the unusual topography, climatic conditions, isolated semi-natural conditions, and biotic associations, this area presented a wide variety of eastern and western species of mosquitoes, which would suggest an area of transition or ecotone.

Thirty-three species of mosquitoes distributed among two subfamilies, and ten genera were collected. Most of the observations presented in this study were made under natural conditions, however, laboratory experiments of a limited nature were performed on the immature stages of several species.

The largest number of larval collections were made from the tree hole (22.6%), pooled stream (19.6%), and rock hole (13.6%) larval habitats. The most abundant larval mosquitoes collected were Aedes triseriatus (Say) 1823, and Aedes atropalpus (Coquillett) 1902. The most abundant species of adult mosquitoes collected were Culex erraticus (Dyar and Knab) 1905, and Anopheles quadrimaculatus Say 1824, respectively.

Species associated with the transient type larval habitats usually completed their larval development in relatively short periods, however, *Psorophora discolor* (Coquillett) 1903, was an exception to the above statement. Larvae associated with the transient type larval habitats were nearly always species of the Genus *Aedes* or *Psorophora*.

The permanent type larval habitats, particularly the impoundments, presented a relatively small number of *Culex erraticus*, and *Anopheles quadrimaculatus* larvae. Larvae were most abundant in this type habitat when aquatic vegetation and intermittent shade was present.

Based on the results of a 1947 (unpublished) study by M. E. Griffith at the Refuge, light trap collection records, indicate that the incidence of *Anopheles quadrimaculatus* has increased considerably, whereas, that of *Culex tarsalis* Coquillett 1896, has decreased sharply. *Aedes atropalpus* and *Aedes zoosophs* Dyar and Knab 1918, are much more abundant at the Refuge than previously indicated in the literature. The collection of *Anopheles barberi* Coquillett, 1903, and *Toxorhynchites rutilus septentrionalis* (Dyar and Knab) 1907, at the Refuge, are westward extensions of the State distribution of these species. The occurrence of *Orthopodomyia alba* Baker 1936, at the refuge, constitutes a new state record and is the most westward record known for this species.

Laboratory experiments suggest that the seasonal periodicity of tree hole species of mosquitoes, appears to be directly related to temperature rather than the length of the photoperiod.

Hydrocarina of the Genera *Arrenurus* and *Thyas* were collected on numerous occasions from females of various species of mosquitoes. *Arrenurus* sp. were collected on females of *Anopheles quadrimaculatus* and to a lesser degree on females of *Anopheles punctipennis* (Say) 1823, and *Culex erraticus*. The water mite *Thyas stoll* Koenike 1895, was collected from several females of *Aedes zoosophs*. Microfilm \$2.75; Xerox \$4.40. 84 pages.

PERIPHERAL NERVE FUNCTION IN RELATION TO HIBERNATION

(Order No. 61-3121)

Theodore Herbert Kehl, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Peter Morrison

Most mammalian peripheral nerves will not conduct at temperatures below 12°C.; therefore, it would seem necessary for a hibernating animal to have some form of adaptation to allow for conduction during hibernation at lower temperatures.

This thesis describes a series of experiments which demonstrate that the peripheral nerve of the 13-lined ground squirrel is further adapted (in relation to the golden hamster) for function at low hibernating temperatures. These experiments show a linear relationship between conduction velocity and excitability (as measured by the reciprocal threshold voltage). Furthermore, there was rotation of these temperature functions so that conduction and excitability were enhanced at low (hibernating) temperatures, and depressed at high (body) temperatures.

The refractory period of the sciatic nerve of the 13-lined ground squirrel was shown to be a logarithmic function of temperature. The Q_{10} of recovery of the refractory period was shown to increase during the hibernating season, possibly allowing for greater response to temperature as the ground squirrel aroused. Higher values for the Q_{10} of recovery were postulated to be advantageous to this animal in that an increase in temperature will decrease the refractory period more and, therefore, improve the ability of the animal to accurately transmit information.

Because the observed alterations seemed to occur as a function of the time of year without regard to environment or condition of the animal, the possibility that altered endocrine levels were the cause of the observed changes was investigated. It was shown that the temperature functions of conduction and excitation, after hypophysectomy of the albino rat, changed in exactly the same manner as occurred during the induction of hibernation in the 13-lined ground squirrel. Replacement of several individual hormones in the hypophysectomized rat showed that most of these hormones increased the temperature functions. Therefore, the concept that alterations in the temperature functions of the peripheral nerves of the 13-lined ground squirrel during induction into hibernation is the result of decreased endocrine secretion, is supported.

An hypothesis explaining the observed changes in temperature functions in terms of physical alterations in the nerve membrane is presented.

Microfilm \$2.75; Xerox \$5.80. 117 pages.

AUXIN CONTENT OF EXTRACTS OF CERTAIN APHIDS, APHID HONEYDEW AND APHID HOST PLANTS IN RELATION TO ASPECTS OF HOST PLANT RESISTANCE.

(Order No. 61-3015)

Fowden Gene Maxwell, Ph.D.
Kansas State University, 1961

The following auxins in extracts of various green plant varieties were detected in significant amounts by biological assay, using the *Avena* coleoptile test, and identified on the basis of computed Rf values of known compounds: (1) Reno barley - 3-indoleacetic acid, indolepyruvic acid, or 3-indolebutyric acid, Ethyl-3-indoleacetate, plus two unknown auxins; (2) Dicktoo barley - 3-indoleacetic acid or indolepyruvic acid, 3-indolebutyric acid plus two unknown auxins; (3) Pawnee wheat - 3-indoleacetic acid and indolepyruvic acid; (4) Dickinson wheat - no known auxins in significant amounts, one unknown auxin in significant amounts; (5) White Martin sorghum - 3-indoleacetic acid, 3-indolebutyric acid, 3-indoleacetoneitrile; (6) Kentucky I barley - 3-indoleacetic acid, and/or indolepyruvic acid; (7) alfalfa clone 50-1266 - 3-indoleacetic acid, indolepyruvic acid, 3-indolebutyric acid, 3-indoleacetoneitrile and/or Ethyl-3-indoleacetate; (8) alfalfa clone C84 - 3-indoleacetic acid and 3-indolebutyric acid; (9) broad bean - 3-indoleacetic acid, indolepyruvic acid and 3-indolebutyric acid.

Uninfested susceptible varieties, especially Reno barley and Pawnee wheat, contained more different auxins and usually in higher concentrations than did the uninfested resistant varieties.

Aphid infestation reduced significantly the acid auxin content of plant varieties studied except Dickinson wheat. A significant increase in neutral auxins was observed with infested susceptible Pawnee wheat. Susceptible varieties contained neutral auxins whereas resistant varieties did not.

Auxins were detected and identified for the first time in honeydew from aphids. The following auxins in aphid honeydew were detected: honeydew from (1) greenbugs on Reno barley - 3-indoleacetic acid, indolepyruvic acid, Ethyl-3-indoleacetate plus two unknown compounds; (2) greenbugs on Dicktoo barley - no known auxins present in significant amounts, general growth inhibition; (3) greenbugs on Pawnee wheat - 3-indoleacetic acid, 3-indolebutyric acid, 3-indoleacetonitrile; (4) greenbugs on Dickinson wheat - 3-indolebutyric acid; (5) greenbugs on Kentucky I barley - 3-indoleacetic acid, 3-indolebutyric acid; (6) corn leaf aphid biotypes KS-1, KS-2, KS-3, KS-4 on Reno barley and KS-1, KS-2, KS-3 on Kentucky I barley and White Martin sorghum - 3-indoleacetic acid, 3-indolebutyric acid, plus one significant inhibitor; (7) spotted alfalfa aphid and pea aphid on 50-1266 alfalfa clone - 3-indoleacetic acid, 3-indolebutyric acid; (8) pea aphid on broad bean - 3-indoleacetic acid.

The auxins present in aphid honeydew collected from four different species feeding on different host plants revealed a striking similarity to auxins present in the corresponding host plants. The discovery of the presence of auxins in aphid honeydew and removal via the plant sap contributes materially to an understanding of why aphids are so effective in stunting plant growth. Significantly less acid auxins were removed from resistant than susceptible varieties even though significant differences of inherent acid auxins did not exist.

The four species of aphids compared favorably in their ability to remove significant quantities of auxins from host plants. Greenbugs were observed to extract quantities of all auxins detected in the host. No significant differences were observed between amounts or kinds of auxins extracted by spotted alfalfa aphid and pea aphid feeding from the same susceptible 50-1266 alfalfa clone. The corn leaf aphid appeared to be highly effective in extracting and concentrating 3-indoleacetic acid and 3-indolebutyric acid.

A significant inhibitor was present in all the corn leaf aphid biotype honeydew except KS-1 on White Martin sorghum and was apparently derived or concentrated by the aphid as no significant inhibitor was present in the host plant material. The corn leaf aphid biotypes (KS-1, KS-2, KS-3, KS-4) differed by having significantly greater or smaller concentrations of growth hormones identified as 3-indoleacetic acid, 3-indolebutyric acid and an unknown growth inhibitor present in the honeydew while feeding on the same and different hosts.

The following auxins were detected in extracts of homogenized greenbugs from different resistant and susceptible hosts: (1) Reno barley - 3-indoleacetic acid, 3-indolebutyric acid; (2) Dicktoo barley - no auxins present in significant amounts; (3) Pawnee wheat - indolepyruvic acid; (4) Dickinson wheat - no auxins present in significant amounts, growth inhibition present. Homogenized pea aphids that had previously fed on broad bean tissue showed 3-indoleacetic acid present in significant amounts.

Auxins were found in significant amounts in extracts of aphids that had fed on susceptible plants and were absent in aphids that had fed on resistant varieties.

Auxins present in greenbugs and pea aphids were significantly reduced by a short starvation period prior to analysis. The filter chamber present in aphids is believed to be largely responsible for enabling auxins to pass largely unchanged through the digestive tract.

Significant reduction in growth of oat coleoptiles in nutrient solution containing 3-indoleacetic acid was affected by greenbug feeding. This suggested that greenbugs may be partially blocking enzymatic biosynthesis of free auxins from amino acids through inhibitors present in their salivary juices.

Results in general indicated a relationship between host plant resistance and neutral auxin content and further indicated that differences observed between resistant and susceptible plants may be more closely related to the ability or inability of aphids to reach, recognize, or utilize the phloem tissue where auxins possibly exist in greater concentration. There are probably still other unknown factors that may contribute important roles in the final determination of whether a plant is resistant or susceptible to certain insect attack.

Auxins appear to be concerned primarily with the tolerance component of resistance and not preference unless an auxin acts as a token or attractive substance to the aphid. Further, auxins are probably not related to antibiosis unless an auxin is a possible source of a necessary nutrient. This study presents the first known evidence of the basis of the tolerance component of resistance.

Microfilm \$2.75; Xerox \$8.60. 189 pages.

CULTIVATION IN VITRO OF VARIOUS TISSUES OF THE NEWT, *TRITURUS VIRIDESCENS* *VIRIDESCENS* (RAFINESQUE).

(Order No. Mic 61-1577)

Joseph H. McSweeney, Ph.D.
Fordham University, 1961

Mentor: Professor E. R. Witkus, Ph.D.

Explants of liver, lung, spleen, kidney and urinary bladder of the newt, *Triturus viridescens* were cultured at room temperature in Maximow depression slides, Leighton and roller tubes in a medium composed of one part chick plasma, one part chick embryo extract (EE-50) and horse serum. Tissues isolated from organisms during months of November through February showed no cell growth in culture. If, during this period, explants are treated with 0.5% trypsin (Difco Bacto-Trypsin 1:250) in Tyrode's B.S.S. for 8-10 minutes prior to being placed in culture, a cell growth is obtained which excels that observed at any other time.

Treated explants of liver show growth of hepatic parenchyma cells, bile duct epithelial cells, fibroblasts and lymphoid hemoblasts. Three month old cultures contain two types of epithelial sheets. One type consists of long, finger-like cords composed of large, heavily granular, polygonal cells. The cytoplasm of these cells show a strong PAS positive reaction. The second type consists of a membranous sheet composed of large, faintly granular,

polygonal cells. Mitotic divisions were observed more frequently in the second sheet.

In the first week of culture, oval lymphoid hemoblasts migrate from the liver explants into the growth zone forming a band of cells around the explant as they flatten on the coverglass. Both small and large sized lymphoblast cells in the band undergo cytodifferentiation giving rise to new hemoblast cells of both types and to young granulocytes. The latter cells differentiate into mature polymorphonuclear leucocytes which migrate from the band into the periphery of the culture medium.

Average length of mitotic cycle (mid prophase - late telophase) of the lymphoid hemoblasts is 1 hour 15 minutes. The mitotic index of these cells is high, the cells dividing every 18-24 hours if the medium is frequently renewed.

After 48 hours in culture, large spindle-shaped fibroblasts migrate into the growth zone. Phase contrast examination of the cells reveals actively moving, long filamentous mitochondria in the peripheral hyaline cytoplasm. As the cells increase in age, they become filled with vacuoles which slowly increase in size. Division of these cells is highly aberrant, whereas division of young cells is regular, averaging 2 hours 15 minutes in length.

Treated explants of lung give rise to ciliated and non-ciliated epithelial sheets. The former migrates outward on the surface of the coagulum, the latter near or on the coverglass. Ciliated epithelial cells display a high degree of proteolytic activity as indicated by the liquefaction of the coagulum. Extension of the sheets is due mainly to the migratory activities of the individual cells. Cell divisions are seen more frequently in the ciliated epithelial sheet, usually in cells close to the explant.

Cultures of treated explants of spleen show growth of reticulocytes. The cell superficially resembles a fibroblast cell but differs from it in possessing an eccentrically placed nucleus, less vacuolar cytoplasm, and in displaying greater mitotic activity. Small lymphocytes, thrombocytes and large macrophages occasionally appear in the medium.

Treated explants of kidney give rise to ciliated epithelial cell sheets and fibroblast cells. The sheets are identical in form and activity with the ciliated epithelial sheets in lung cultures. The fibroblasts are indistinguishable from liver fibroblast cells.

Cultures of treated explants of urinary bladder show a rapid growth of sheets of non-ciliated epithelial cells. Extension of the sheets is due not only to the migratory activities of the individual cells but also to the high rate of cell proliferation. The dividing cells are found in all areas of the sheet, but more often close to the explant and at the periphery. Cells of selected 4-day old cultures were exposed to 0.00033% colchicine in B.S.S. Enumeration of C-metaphase figures reveals a peak in the log phase of growth occurring 24-28 hours after the renewal of the medium. Chromosome counts of exploded C-metaphase figures show that the diploid number of chromosomes is 22.

Microfilm \$2.75; Xerox \$5.20. 102 pages.

AN INVESTIGATION OF GROWTH, DEVELOPMENT AND DIMORPHISM IN COCKROACHES (Orthoptera:Blattidae).

(Order No. 61-3016)

Erlinda Rosario Quiaoit, Ph.D.
Kansas State University, 1961

Twenty-four species of cockroaches in six subfamilies were studied in a search for features which might correlate with wing dimorphism. The main lines of investigation were: (1) spermatogenesis in the immatures, and (2) comparative anatomy of external and internal reproductive structures.

For this investigation the first instar cockroaches were sexed by the use of characteristics of the posterior margin of the last abdominal sternite. Spermatogenesis was traced in these immature individuals and was found to reach a peak at the same relative time in the four species studied; two of these had short life cycles and two had long lives. Stages of maturation of the germ cells can be correlated with the nymphal instars, which can be determined accurately by using intermandibular measurements. *Blatta orientalis* was found to be about equal to other domestic species in rate of spermatogenesis and decline of the testes, earlier published reports to the contrary. Certain outdoor species, on the other hand, apparently do suffer rapid degeneration of the testes in the adult state.

The internal anatomy of the male cockroach reproductive system did not reveal much in the way of basic differences nor did it correlate with the wing characteristics of the species studied. Differences occurred only in the number, shape, and size of the organs concerned but these follow established subfamily relationships. The structures considered to be part of the internal male reproductive system included the testes, vasa deferentia, accessory glands, ejaculatory duct, seminal vesicles, and phallic glands.

The external genitalia, as a rule, consists of right and left phallomeres and a median structure which may be designated the ventral phallomere in some and the intromittent organ in others. The right and left phallomeres of the *Blattinae* were the most complex in structure; for this reason a new system of nomenclature for the parts was devised in order to simplify the comparative study; previously published descriptions were confusing. The new approach presented here should be a useful tool for Blattid taxonomists.

The phallomeres are much simplified structures in the other subfamilies. An apparent exception to this general statement is *Supella supellectilium* in which the structures appear to be intermediate in complexity. The other members of the *Pseudomopinae* have very simple intromittent organs, a hook type of left phallomere, and a simplified "catch" type of right phallomere. The hook and "catch" are transposed in three of the remaining four subfamilies. This shift in accessory copulatory structures parallels a similar shift in the reproductive habits of the females.

No evidence was uncovered to indicate that wing dimorphism in cockroaches can be associated with any other type of variation in the features thus far studied.

Microfilm \$2.75; Xerox \$5.00. 98 pages.

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